MONITORING STUDY FOR THE LAKE BRUCE WATERSHED LAND TREATMENT PROJECT AREA

FULTON COUNTY, INDIANA

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EXECUTIVE SUMMARY

In the spring of 2001, the Fulton County Soil and Water Conservation District (SWCD) received funding from the Indiana Department of Natural Resources (IDNR) Division of Soil Conservation Lake and River Enhancement (LARE) Program to collect chemical, biological, and habitat baseline data in the Lake Bruce Watershed land treatment project area. Best Management Practice (BMP) projects are planned for implementation in the watershed through the Watershed Land Treatment portion of the LARE Program. The Fulton County SWCD desired baseline stream data that can be used in the future to determine the success of implemented projects.

The Lake Bruce Watershed is part of the much larger Tippecanoe River Basin. The outlet of Lake Bruce flows west away from the Lake Bruce Watershed until it converges with the Tippecanoe River which runs south to its confluence with the Wabash River near Lafayette. The Wabash River eventually joins the Ohio River in the southwest corner of Indiana. The study area is part of the Northern Lakes Natural Region (Homoya et al., 1985) where Wisconsin-age glaciers carved out the rolling topography and numerous lakes that characterize the area. All of the tributaries to Lake Bruce are classified as legal drains and according the county drainage board applications to the Indiana Department of Natural Resources (IDNR) Division of Water, two of them are scheduled for intensive dredging projects within the next year.

Chemical and biological data for Baker Ditch and Overmeyer Ditch, tributares to Lake Bruce, were collected in the spring and fall of 2001. Sampling event timing was targeted at collection of filter/scraper-type organisms in the spring and shredder-types in the fall. Habitat quality and resources were assessed during the spring sampling event.

General chemical data collected during the study indicate that minimal water quality conditions are insufficient for aquatic biota. Accordingly, assessment of the biota itself and of habitat conditions indicates impairment as well. mIBI scores ranged from 0.3 to 1.7, scores indicative of a severely impaired insect community. Pollution-tolerant organisms dominated the samples, and smaller quantities of insects were collected when compared to healthier systems. In general, habitat resources were also less than optimal. Pool-riffle-run development and substrate quality necessary for healthy biotic communities were found to be degraded in the sample reaches.

Based on data collected during the study, relevant management recommendations include: 1) reevaluation of the current drainage maintenance plan and coordination with the county drainage board to develop a sustainable drainage plan to prevent future soil loss to waterways; 2) discontinuation of the current monitoring study until a sustainable drainage or watershed management plan has been addressed; 3) consideration of different biological sampling methodologies when a monitoring program is again undertaken in the future; 4) extension of management to the watershed level; and 5) provision of information and education to landowners in the watershed.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

TABLE OF APPENDICES

INTRODUCTION

The Lake Bruce Watershed Land Treatment Project Area is located in Fulton County, Indiana (Figure 1) and is 4,078 acres (1,651 ha) in size (Figure 2). Three ditches drain the area: Baker Ditch (south), Overmyer Ditch (east), and Frasa Ditch (north). The watershed lies along the western edge of the Northern Lakes Natural Region (Homoya et al., 1985). Numerous freshwater glacial lakes characterize this Natural Region. Bruce Lake is one of these glacial lakes. Historically, bog, marsh, lake, sedge meadow, prairie, and deciduous forest community types covered the area. Currently, land use within the watershed is primarily agricultural (82%). Other land uses include open water (6%), forest (5%), wetlands (4%), and residential development (3%).

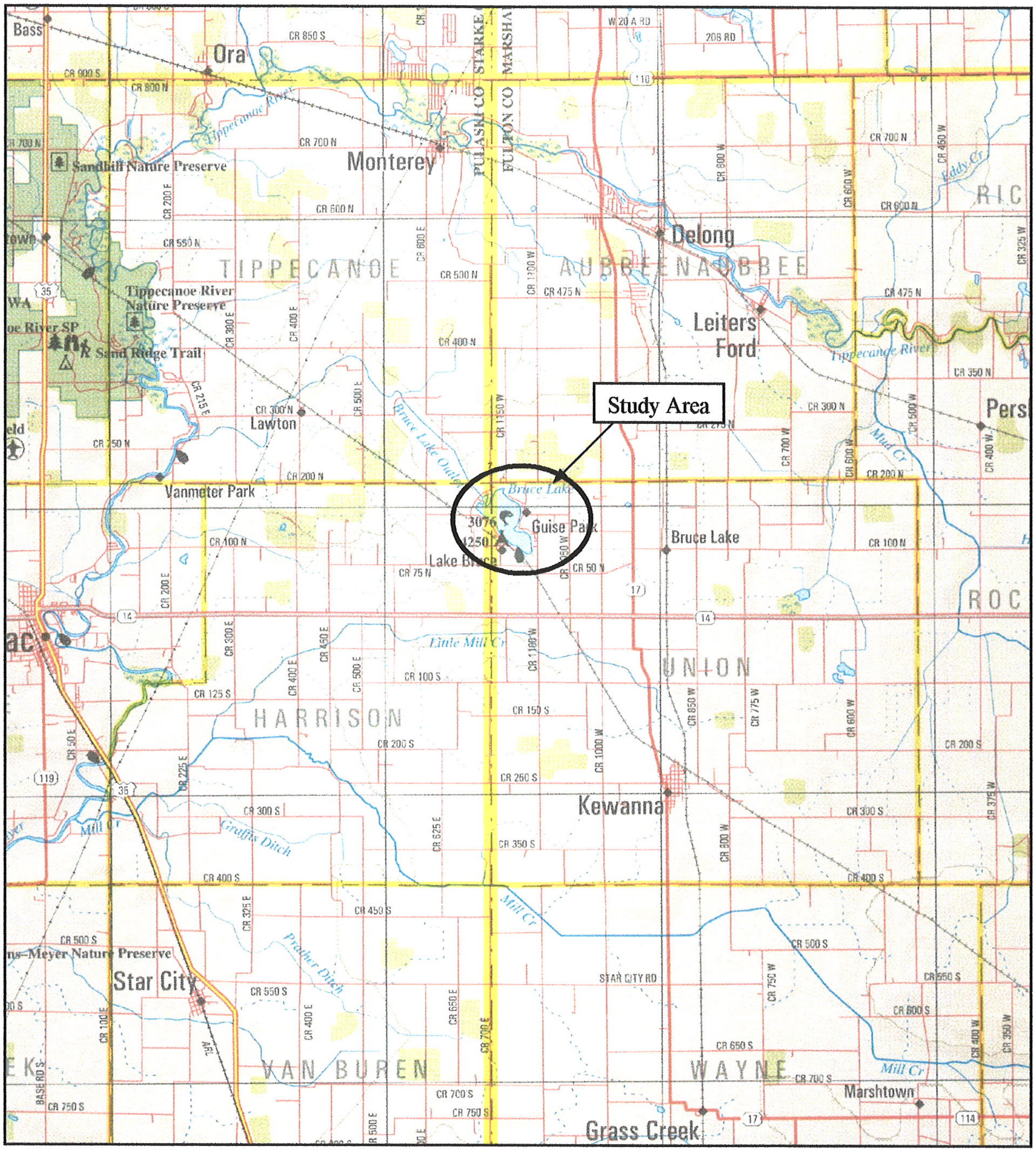
Lake Bruce and its watershed have been the subject of a sizeable amount of research (Table 1). Most of the studies have been aimed at protecting and enhancing the beneficial uses of Lake Bruce. According to Indiana Clean Lakes data (IDEM, 2000), Lake Bruce is hypereutrophic, and the Lake Bruce Diagnostic Study (Eviston et al., 1990) suggested that "lake management (would) be hindered until watershed and nutrient loading to the lake are drastically reduced." The Watershed Land Treatment Program administered by the Indiana Department of Natural Resources (IDNR) Division of Soil Conservation funded the current study in order to gather baseline biological data at a watershed level before best management practice implementation in the immediate area ensues.

TABLE 1. Research and investigations conducted at Bruce Lake from 1955 to present.

Year	Entity	Study/Investigation
1955	USGS	Construction of Lake Bruce bathymetric map
1967	ISBH	Bacteriological study at one sampling location
1967	IDNR	Fish community and macrophyte survey
1968	ISBH	Bacteriological study at seventeen sampling locations
1969	ISBH	Bacteriological study at seventeen sampling locations
1970	IDNR	Fish community and macrophyte survey
1973	IDNR	Fish community and macrophyte survey
1974	IDNR	Gizzard shad renovation and largemouth bass fingerling stocking
1975	IDNR	Fish community and macrophyte survey
1975	ISBH	Survey of physical/chemical parameters for calculation of BonHomme eutrophication index
1976	LBA	Dye testing of septic tanks around Lake Bruce
1976	IDNR	Fish community and macrophyte survey
1977	IDNR	Fish community and macrophyte survey
1977	LBA	Dye testing of septic tanks around Lake Bruce
1978	IDNR	Fish community and macrophyte survey
1978	IDNR	Stocking of northern pike fingerlings
1978	LBA	Dye testing of septic tanks around Lake Bruce
1979	IDNR	Fish community and macrophyte survey
1980	IDNR	Fish community and macrophyte survey
1982	IDNR	Fish community and macrophyte survey

1983	SWCD, FCDB, and LBA	Development of a watershed protection plan
1985	ISBH	Bacteriological study at five sampling locations
1988	IU	Survey of physical/chemical parameters for calculation of BonHomme eutrophication index
1990	IDNR and LBA	Watershed diagnostic study
1991	IDNR	Pike management report
1993	IDNR	Fish community and macrophyte survey
1995	IDEM-BSS	Fish community assessment and IBI calculation for the Lake Bruce Outlet
1999	LBA	Lake Bruce Conservancy District establishment
2000	JFNA	Lake Bruce Enhancement Project
2000	IDNR	Fish community and macrophyte survey
2000	IDEM-CLP	Clean Lakes Program Assessment of Lake Bruce

USGS = United States Geological Survey
ISBH = Indiana State Board of Health
IDNR = Indiana Department of Natural Resources
LBA = Lake Bruce Association
SWCD = Fulton County Soil and Water Conservation District
FCDB = Fulton County Drainage Board
IU = Indiana University
IDEM-BSS=Indiana Department of Environmental Management Biological Studies Section
IDEM-CLP=Indiana Department of Environmental Management Clean Lakes Program
IBI=Index of Biotic Integrity
JFNA=J.F. New & Associates, Inc.



Scale: 1" = 2.5 Miles

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FIGURE 1. Location Map
Monitoring Study for the Lake Bruce Watershed
Land Treatment Project Area
Fulton County SWCD
Fulton County, Indiana

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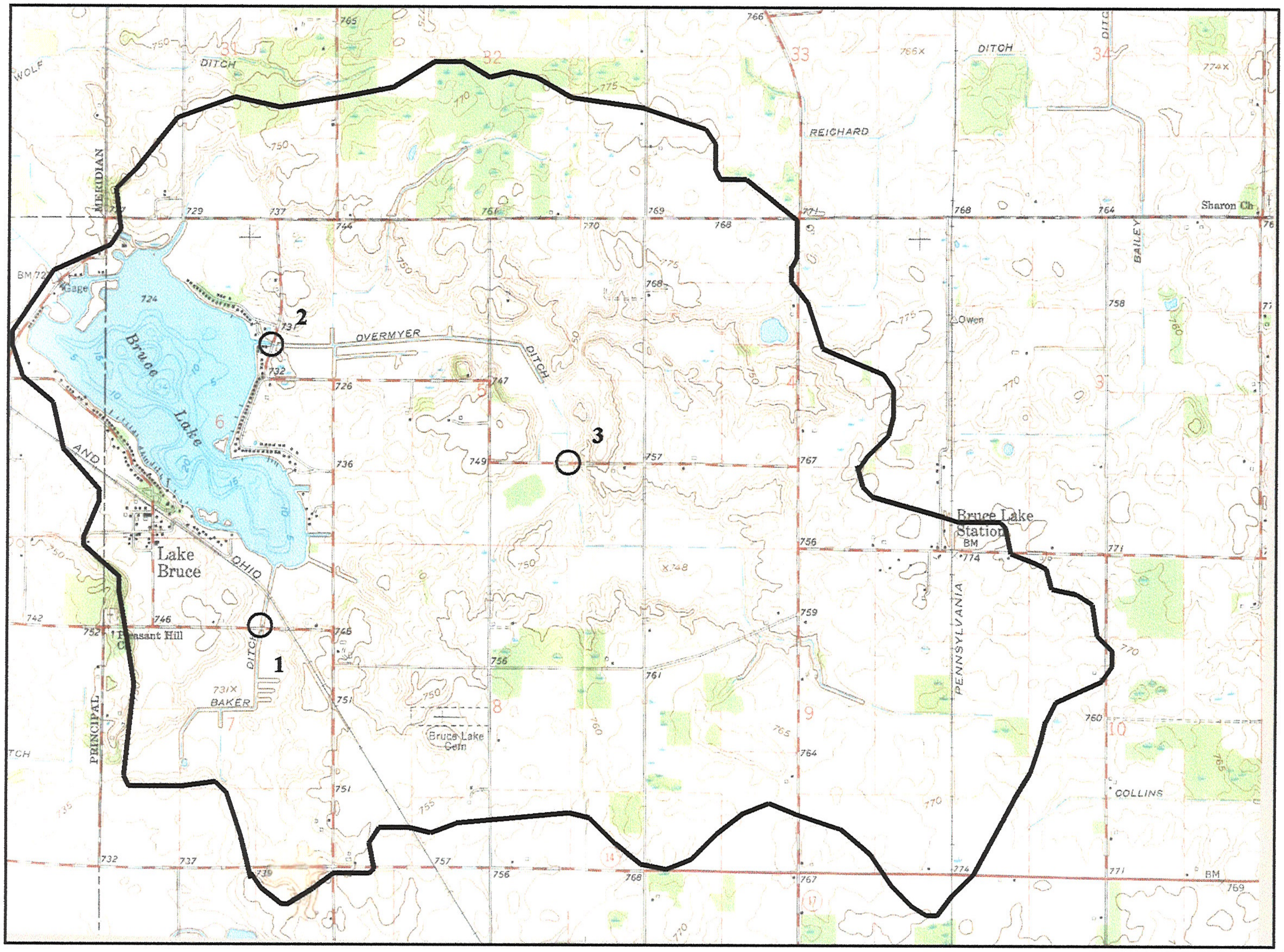

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FIGURE 2. Sampling locations within the Lake Bruce Watershed, Fulton County, Indiana

Scale: 1" = 2000'

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HISTORICAL DATA

Fish Communities

Since 1967, Lake Bruce has been the focus of 16 fish community projects or studies (Table 1). Table 2 lists the individual species collected by the IDNR in Lake Bruce from 1967-2000. Since 1975, rough fish including carp, gizzard shad, and gar have dominated the catch. The most troublesome issue is that the shad population has been expanding in the lake since 1970. An overabundance of shad creates problems for lacustrian systems because they are a keystone species and tend to control the food web due to their efficient feeding strategies (Stein et al., 1995). Because they prefer zooplankton as food, they promote cyanobacterial (blue-green algae) dominance and out-compete small, young gamefish which also require zooplankton for food. From 1978 to 1982, shad composed 50-60% of the total fish abundance. Shad were the most abundant fish in 1991 and 1993 as well; however shad abundance by weight decreased from 54% in 1982 to 25% in 1993. The most recent survey (IDNR, 2000) also documented shad as the dominant species, but they represented only 21% of the total number captured. Although rough fish still composed 52% of the biomass during the 2000 survey, gizzard shad have decreased in relative abundance post 1982. The increase in gar numbers and the implementation of the 12-inch largemouth bass size limit in 1992 have resulted in increased predatory pressure on the shad population and are helping to control their numbers.

TABLE 2. Fish species sampled in Bruce Lake by the IDNR from 1967-2000. An X indicates species presence.

Species	'67	'70	'73	'75	'76	'77	'78	'79	'80	'82	'93	'00
Black bullhead		X						X	X			
Black crappie	X		X	X	X		X	X	X	X	X	X
Blacknose dace												X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X
Bowfin	X	X	X	X	X	X			X			X
Brook silversides	X		X	X					X			X
Brown bullhead	X	X	X	X	X	X	X	X	X		X	X
Carp	X	X	X	X	X	X	X		X	X	X	X
Channel catfish						X						X
Gizzard shad	X	X	X	X	X	X	X	X	X	X	X	X
Golden shiner	X	X	X	X	X	X	X	X	X		X	X
Grass pickerel	X						X					
Green side darter												X
Green sunfish	X		X									
Hybrid striped bass												X
Lake chubsucker	X	X	X		X	X	X					
Largemouth bass	X	X	X	X	X	X	X	X	X		X	X
Longear sunfish				X	X	X	X				X	X
Longnose gar		X		X		X	X				X	X
Northern pike								X	X			
Pumpkinseed	X	X	X	X	X	X	X		X		X	X
Redear	X										X	X

Shortnose gar						X						
Spotted gar	X	X	X	X	X	X	X	X	X		X	X
Warmouth	X	X	X	X	X	X	X	X	X		X	X
White crappie	X	X	X	X	X	X	X	X	X	X	X	X
White sucker		X	X	X	X	X	X		X		X	X
Yellow bullhead	X	X		X	X		X	X	X		X	X
Yellow perch	X	X	X	X	X	X	X	X	X	X	X	X

The IDEM Biological Studies Section surveyed the fish community of the Lake Bruce Outlet stream in 1995 and calculated an Index of Biotic Integrity (IBI) for the stream. Karr (1981) first developed the IBI for evaluating biotic integrity of fish communities. Simon (1997) further modified and calibrated the IBI for use in the Northern Indiana Till Plain Ecoregion of Indiana. Biological integrity is defined as, "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the best natural habitats within a region" (Karr and Dudley, 1981).

The IBI is designed to assess biotic integrity directly through twelve attributes of fish communities in streams. These attributes fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. After data from sampling sites have been collected, values for the twelve metrics are compared with their corresponding expected values (Simon, 1997) and a rating of 1, 3, or 5 is assigned to each metric based on whether it deviates strongly from, somewhat from, or closely approximates the expected values. The sum of these ratings gives a total IBI score for the site. The best possible IBI score is 60 (Table 3).

TABLE 3. Attributes of Index of Biotic Integrity classification.

IBI	Integrity Class	Attributes
58-60	Excellent	Comparable to the best situation without human disturbance.
48-52	Good	Species richness somewhat below expectations.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists.
12-22	Very Poor	Few fish present. Mostly introduced or tolerant forms.
0	No Fish	Repeat sampling finds no fish.

Source: Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana III. Northern Indiana Till Plain (Simon, 1997).

Though the sampling site is not technically in the watershed, fish community health in the Lake Bruce outlet where IDEM sampled in 1995 is related to Lake Bruce Watershed health and the quality of water exported from Lake Bruce. The IBI score calculated by IDEM places the Lake Bruce outlet between the fair and poor integrity classes. Fish communities belonging to these two classes are typically dominated by omnivores, pollution-tolerant forms, and habitat generalists. Usually few top carnivores exist, and growth rates and condition factors are depressed (Simon, 1997). In general, the fish community of the Lake Bruce outlet stream was composed of tolerant individuals (Table 4). A large portion of the community was composed of generalist or omnivorous feeders, indicating poor trophic development. Five of the 14 species are considered pioneer species which tend to dominate in unstable environments affected by anthropogenic stress (Simon, 1997).

TABLE 4. Trophic guild, tolerance, lithophile, and pioneer status of members of the Lake Bruce outlet stream fish community.

Common Name	Trophic Guild	Tolerance	Lithophilic	Pioneer
Creek chub	generalist	highly tolerant	no	yes
Blacknose dace	generalist	tolerant	yes	no
Hornyhead chub	insectivore	intolerant	no	no
Central stoneroller	herbivore	intermediate	no	yes
Bluntnose minnow	omnivore	highly tolerant	no	yes
Fathead minnow	omnivore	highly tolerant	no	yes
Spotfin shiner	insectivore	intermediate	no	no
Striped shiner	insectivore	intermediate	yes	no
White sucker	omnivore	highly tolerant	yes	no
Northern hogsucker	insectivore	intolerant	no	no
Spotted sucker	insectivore	intermediate	yes	no
Mottled sculpin	insectivore	intermediate	no	no
Bluegill	insectivore	intermediate	no	no
Johnny darter	insectivore	intermediate	no	yes

Source: Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana III. Northern Indiana Till Plain (Simon 1997).

Natural Communities and Endangered, Threatened, and Rare Species

The Indiana Natural Heritage Data Center database provides information on the presence of endangered, threatened, or rare species, high quality natural communities, and natural areas in Indiana. The database was developed to assist in documenting the presence of special species and significant natural areas and to serve as a tool for setting management priorities in areas where special species or habitats exist. The database relies on observations from individuals rather than systematic field surveys by the IDNR. Because of this, it does not document every occurrence of special species or habitat. At the same time, the listing of a species or natural area does not guarantee that the listed species is present or that the listed habitat is in pristine condition. To assist users, the database includes the date that the species or special habitat was last observed and reported in a specific location.

According to the database records, the Lake Bruce Watershed supports the state-significant wetland/fen community type. In 1938, Beck water-marigold (*Bidens beckii*), a state endangered aquatic plant was documented in the area. No other documentations of distinctive, rare, and/or endangered fauna or flora in the watershed have been reported.

METHODS

Sampling Timing and Locations

Water quality, macroinvertebrates, and habitat quality were sampled at three locations on June 26 and October 31, 2001. The sampling times were targeted at collection of filter/scraper-type organisms in the spring and shredder-type organisms in the fall. Base flow conditions are necessary for an unbiased sample. Because the spring was wet and because the sampling locations are at lake level, high water and flooded conditions caused the spring collection to be slightly postponed. The three sampling locations were chosen by the Fulton County Soil and Water Conservation District (SWCD): Baker Ditch where it crosses CR 75 North (Site 1), Overmeyer Ditch where it crosses CR 1100 West (Site 2), and Frasa Ditch where it crosses CR 200 North (Figure 2). Due to vocal threats from the owner of the land on Frasa Ditch, this site was not sampled. Instead, samples were taken on Overmeyer Ditch where it crosses CR 125 North (Site 3). Sampling at this location on Overmeyer Ditch provides baseline data that can be used to evaluate future projects. Table 5 contains descriptions of the sampling locations including their UTM Zone 16 NAD 1983 coordinates. Photos of the sites appear in Appendix A.

TABLE 5. Detailed sampling location information for the Lake Bruce Watershed.

Site #	Stream Name	Road Location	Place Sampled	UTM Zone 16 NAD 1983 Coordinates
1	Baker Ditch	intersection with CR 75N	downstream of road crossing	545,579.31m x 4,546,230.01m
2	Overmeyer Ditch	intersection with CR 1100 W	upstream of road crossing	545,629.68m x 4,547,630.33m
3	Overmeyer Ditch	intersection with CR 125 N	downstream of road crossing	547,160.08m x 4,547,054.93m

It is important to note that all the sampling locations are on streams that are designated as legal drains. Legal drains are important for water conductance to sustain a variety of land uses, including agriculture. According to IDNR Water Application Database Records, 1900 ft (580 m) of Baker Ditch is scheduled for maintenance due to a blocked tile pump station. IDNR Division of Water permits indicate that 1-1.5 feet of sediment will be removed from the lake to a point about 1000 feet upstream of the CR 75 N crossing (Figure 3). Additionally, Overmeyer Ditch is scheduled for cleaning and removal of 1-2 feet of sediment 500 feet downstream and 800 feet upstream of CR 1100 W (Figure 3). Although these projects will directly involve two of the three current study locations, the work had not yet been initiated prior to either the June or October samplings. It is important to remember that projects constructed within the drainage easement require County Drainage Board permission. Projects may not be permitted if they impede drainage.

Water Quality Sampling Methods

Water quality measurements including pH, conductivity, temperature, and dissolved oxygen were measured prior to each collection in June and October. Conductivity was measured using an Orion Quikcheck Model 118 and pH using an Orion Quikcheck Model 106. Temperature and dissolved oxygen were measured using a YSI Model 5500 meter. A brief description of the various parameters follows:

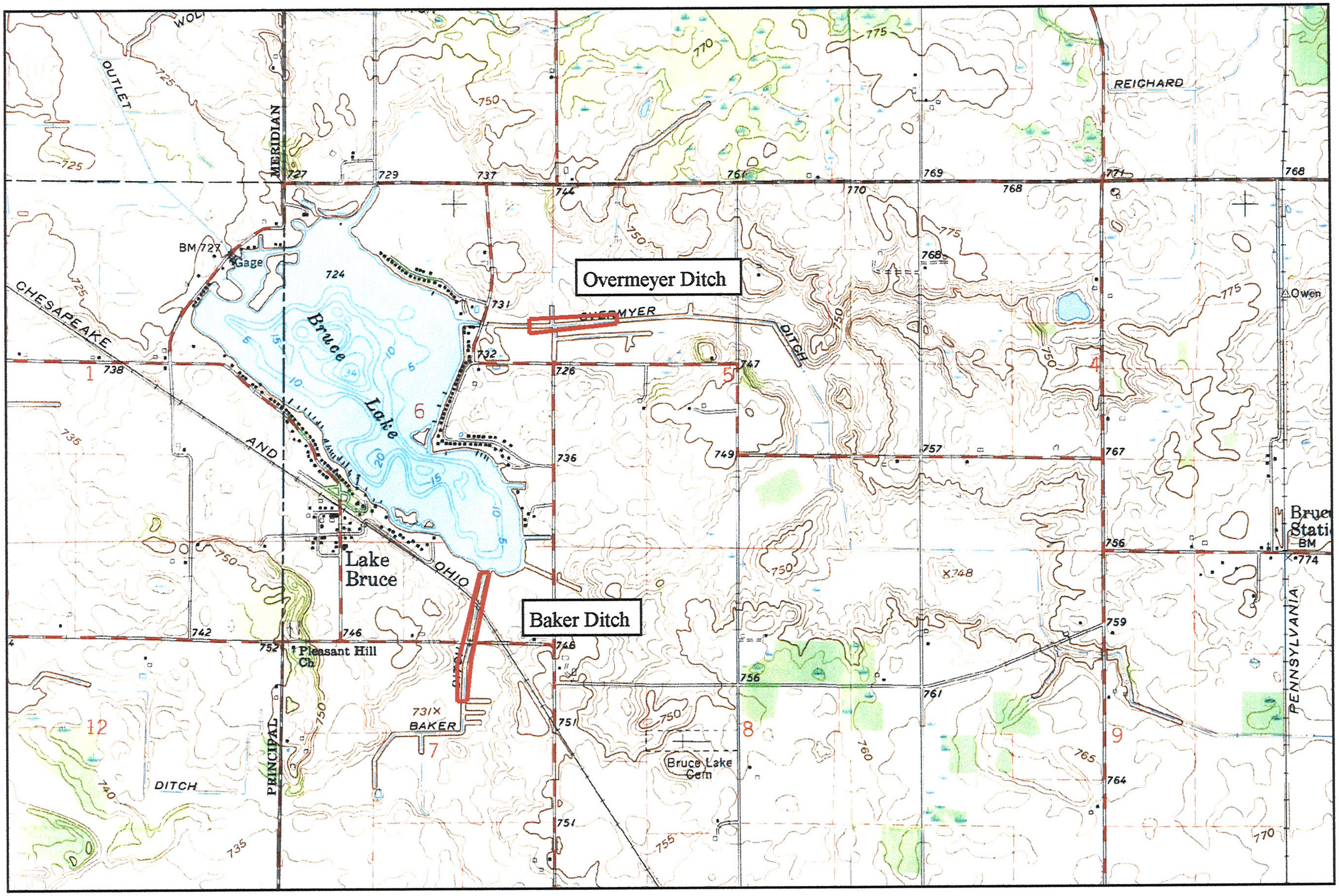

FIGURE 3. Scheduled Fulton County Drainage Board maintenance projects.

Scale: 1" = 2000'

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pH The pH of stream water describes the concentration of acidic ions (specifically H^+) present in the water. The pH also determines the form, solubility, and toxicity of a wide range of other aqueous compounds. The Indiana Administrative Code (327 IAC 2-1) establishes a range of 6-9 pH units for the protection of aquatic life.

Conductivity Conductivity is a measure of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions: on their total concentration, mobility, and valence (APHA, 1995). During low discharge, conductivity is higher than during storm water runoff because the water moves more slowly across or through ion-containing soils and substrates during base flow. Carbonates and other charged particles dissolve into the slow-moving water, thereby increasing conductivity measurements.

Temperature The IAC (327 IAC 2-1-6) sets maximum temperature limits for Indiana streams. Temperatures during the month of May should not exceed 80°F (23.7°C) by more than 3°F (1.7°C). June temperatures should not exceed 90°F (32.2°C). The Code also states that "the maximum temperature rise at any time or place...shall not exceed 5°F (2.8°C) in streams...". Temperature can determine the form, solubility, and toxicity of a broad range of aqueous compounds.

Dissolved Oxygen (D.O.) D.O. is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. Fish need at least 3-5 parts per million (ppm) of D.O. Coldwater fish such as trout generally require higher concentrations of D.O. than warmwater fish such as bass or bluegill. The IAC sets minimum D.O. concentrations at 6 mg/l for coldwater fish. D.O. enters water by diffusion from the atmosphere and as a byproduct of photosynthesis by algae and plants. Excessive algae growth can over-saturate (greater than 100% saturation) the water with D.O. Dissolved oxygen is consumed by respiration of aquatic organisms, such as fish, and during bacterial decomposition of plant and animal matter.

Macroinvertebrate Sampling Methods

Macroinvertebrate samples from each of the three sites were used to calculate an index of biotic integrity using methods established by Environmental Protection Agency (EPA) and IDEM (Barbour et al., 1999 and IDEM, 1996). Aquatic macroinvertebrates are important indicators of environmental change. The insect community composition reflects water quality, and research shows that different macroinvertebrate orders and families react differently to pollution sources. Indices of biotic integrity are valuable because aquatic biota integrate cumulative effects of sediment and nutrient pollution (Ohio EPA, 1999).

Macroinvertebrates were collected during base flow conditions on June 26 and October 31, 2001 using the multihabitat approach detailed in the USEPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, 2nd edition (Barbour et al., 1999). Because of deep silt which made kick-net sampling infeasible, D-nets were utilized to sample available habitat types. Greater than 100 organisms were obtained from each site and preserved in 70-80% alcohol. Sampling nets were carefully examined and rinsed for any remaining organisms prior to leaving the site.

In the laboratory the sample was evenly spread into a pan of 1,925 cm^2 in discreet 5 cm x 5 cm quadrats numbered 1-77 (IDEM, 1996). Organisms in random squares were counted and sorted. Sorting continued until all organisms had been removed from the last quadrat necessary to obtain 100 organisms. Sorted organisms were identified to the family level, and IDEM datasheets were filled out for each sampling event. The family-level approach was used: 1) to collect data comparable to that collected by IDEM in the state; 2) because it allows for increased organism identification accuracy; 3) because several studies support the adequacy of family-level analysis (Furse et al. 1984, Ferraro and Cole 1995, Marchant 1995, Bowman and Bailey 1997, Waite et al. 2000).

Macroinvertebrate data were used to calculate the Family-level Hilsenhoff Biotic Index (FBI). Calculation of the FBI involves applying assigned macroinvertebrate family tolerance values to all taxa present that have an assigned FBI tolerance value, multiplying the number of organisms present by their family tolerance value, summing the products, and dividing by the total number of organisms present (Hilsenhoff, 1988). Organisms of greater tolerance to organic pollution were assigned a greater value on a scale from 1 to 9; therefore, a higher value on the FBI scale indicates greater impairment (levels or organic pollution).

In addition to the FBI, macroinvertebrate results were analyzed using the IDEM mIBI (IDEM, 1996). mIBI scores allow comparison with data compiled by IDEM for wadeable riffle-pool streams in Indiana. Table 6 lists the ten scoring metrics with classification scores of 0-8. The mean of the ten metrics is the mIBI score. mIBI scores of 0-2 indicate the sampling site is severely impaired; scores of 2-4 indicate the site is moderately impaired, scores of 4-6 indicate the site is slightly impaired, and scores of 6-8 indicate that the site is not impaired. IDEM developed the classification criteria based on five years of wadeable riffle-pool data collected in Indiana. The data were lognormally distributed for each of the ten metrics. Each of the ten metric's lognormal distribution was then pentasected with scoring based on five categories using 1.5 times the interquartile range around the geometric mean. Because a different sampling methodology was used in this study, only six of the ten metrics were used for the mIBI calculation: family-level FBI, number of taxa, percent dominant taxa, EPT Index, EPT count to total number of individuals, and EPT count to chironomid count.

TABLE 6. Benthic macroinvertebrate scoring metrics and classification scores used by IDEM in evaluation of riffle-pool streams in Indiana.

	SCORING CRITERIA FOR THE FAMILY LEVEL MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY (mIBI) USING PENTASECTION AND CENTRAL TENDENCY ON THE LOGARITHMIC TRANSFORMED DATA DISTRIBUTIONS OF THE 1990-1995 RIFFLE KICK SAMPLES				
		CLASSIFICATION SCORE			
	0	2	4	6	8
Family Level FBI	≥5.63	5.62- 5.06	5.05-4.55	4.54-4.09	≤4.08
Number of Taxa	≤7	8-10	11-14	15-17	≥18
Number of Individuals	≤79	129-80	212-130	349-213	≥350
Percent Dominant Taxa	≥61.6	61.5-43.9	43.8-31.2	31.1-22.2	≤ 22.1
EPT Index	≤2	3	4-5	6-7	≥8
EPT Count	≤19	20-42	43-91	92-194	≥195
EPT Count To Total Number of Individuals	≤0.13	0.14-0.29	0.30-0.46	0.47-0.68	≥0.69
EPT Count To Chironomid Count	≤0.88	0.89-2.55	2.56-5.70	5.71-11.65	≥11.66
Chironomid Count	≥147	146-55	54-20	19-7	≤6
Total Number of Individuals To Number of Squares Sorted	≤29	30-71	72-171	172-409	≥410

Where 0-2 = Severely Impaired; 2-4 = Moderately Impaired; 4-6 = Slightly Impaired; 6-8 = Nonimpaired

Habitat Sampling Methods

During the spring sampling, physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of in-stream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score. Scores typically range from 20 to 100.

The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of stream segments in Ohio have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas. Scores greater than 75 typify habitat conditions that have the ability to support exceptional warmwater faunas (Ohio EPA, 1999).

RESULTS

Water Quality

Table 7 contains the results of Baker and Overmeyer Ditch water quality sampling efforts in the spring and fall of 2001. During the spring sampling period, pH was elevated at all sampling locations and exceeded the Indiana state standard range of 6-9 units. In general, pH values above 9 cause stress to aquatic life. Values of pH were lower and much closer to neutral during the fall sampling event. Conductivity levels were normal for base flow discharge. Temperatures in June and October were below maximum limits set by Indiana standards (32.2°C or 90°F). In June, dissolved oxygen concentrations at the two sites nearest the lake were very low. These levels fell below the Indiana state standard range of 3-5 ppm. It is not likely that these levels can support warmwater fish communities or the intolerant macroinvertebrate communities indicative of good water quality. Oxygen levels were higher and above the 3-5 ppm state standard range when the water was colder and biological activity lower during the fall.

TABLE 7. Water quality data sampled in the Lake Bruce inlet ditches in the spring and fall of 2001.

Date	Site	pH	Cond. (µmhos)	Temp. (°C)	Dissolved Oxygen (mg/l)
26Jun01	Baker Ditch at CR 75 N (Site 1)	9.4	500	22.0	1.0
31Oct01	Baker Ditch at CR 75 N (Site 1)	6.9	300	11.0	5.4
26Jun01	Overmeyer Ditch at CR 1125 W (Site 2)	9.3	600	22.0	2.2
31Oct01	Overmeyer Ditch at CR 1125 W (Site 2)	7.0	400	12.0	7.8
26Jun01	Overmeyer Ditch at CR 125 N (Site 3)	9.4	600	24.5	7.2
31Oct01	Overmeyer Ditch at CR 125 N (Site 3)	7.0	400	11.8	9.7

Macroinvertebrates

mIBI scores for each sampling site are given in Table 8. Detailed mIBI results and bench sheets are included in Appendix B. The mIBI scores ranged from 0.3 to 1.7. The scores for all three sites in both the spring and fall indicate severe impairment and the inability to support healthy aquatic insect communities. Spring and fall scores were similar for Sites 1 and 2; however, the mIBI score for Site 3 increased 1.4 points between the two sampling events.

TABLE 8. Classification scores and mIBI score for sampling sites on the Lake Bruce inlet ditches as sampled in the spring (26Jun01) and in the fall (31Oct01).

	Site 1 Spring	Site 1 Fall	Site 2 Spring	Site 2 Fall	Site 3 Spring	Site 3 Fall
FBI	0	0	0	0	0	0
No. Taxa (family)	4	0	2	2	0	4
% Dominant Taxa	2	6	0	2	2	6
EPT Index	0	0	0	0	0	0
EPT Count/Total Count	0	0	0	0	0	0
EPT Abun./Chironomid Abun.	0	0	0	0	0	0
mIBI Score	**1.0**	**1.0**	**0.3**	**0.7**	**0.3**	**1.7**

Habitat

QHEI scores are listed in Table 9 for each of the three sampling sites. QHEI datasheets may be found in Appendix C. Site 1 scored the lowest at 26.7, while Site 2 scored the highest at 42. All QHEI scores were lower than the minimum score of 60 found by the Ohio EPA to be conducive to aquatic life support in Ohio streams.

TABLE 9. QHEI scores for sampling sites on the Lake Bruce inlet ditches as sampled in the spring (26Jun01).

Site	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score
Maximum Possible Score	20	20	20	10	12	8	10	**100**
Site 1	1	13	4	8.7	0	0	0	**26.7**
Site 2	8	8	7	9	0	0	0	**32**
Site 3	1	9	5	7	0	0	8	**30**

DISCUSSION

Water Quality, Macroinvertebrate, and Habitat Data

Spring pH and dissolved oxygen parameters were of concern for aquatic life support particularly at Sites 1 and 2. Although the cause of the high pH measurements is unknown, the low dissolved oxygen concentrations were likely the result of decomposition processes in the pooled, stagnant streams near the lake. It is also important to note here that many other chemical contaminants that may affect aquatic life in stream were not measured during this study and may also have contributed to the depressed health of the biotic community.

Macroinvertebrate community analysis suggests either severe water quality impairment, habitat quality impairment, or perhaps both. Macroinvertebrate communities were dominated by tolerant forms causing poor Hilsenhoff FBI scores (Table 8). Even the best FBI score of 6.52 resulted in a "poor" classification with "very substantial pollution likely" (Hilsenhoff, 1988). Table 10 presents the families collected during the spring and fall sampling events and their corresponding tolerance values. In general, organisms collected during both events were pollutant tolerant as indicated by the high tolerance values. The complete lack of any families belonging to the orders Ephemeroptera, Plecotera, or Trichoptera (EPT) lowered the mIBI score and is cause for concern. Organisms belonging to these three orders are typically pollution intolerant and indicate unimpaired conditions. Delong and Brusven (1998) found that agricultural non-point source pollution resulted in a relatively homogeneous assemblage of insects capable of tolerating agricultural alteration. Based on current land use practices in the localized areas, it is likely that agricultural non-point source pollution adversely affects aquatic life and habitat in Lake Bruce tributaries.

TABLE 10. Macroinvertebrate families collected during the spring and fall sampling events and their corresponding tolerance values (IDEM, 1996). The smaller the value, the less pollution-tolerant the family is. NS indicates that the family has not been scored in available literature.

Family	Tolerance	Site 1 Spring	Site 1 Fall	Site 2 Spring	Site 2 Fall	Site 3 Spring	Site 3 Fall
Libellulidae	9	X	X				
Pleidae	NS	X		X			
Ceratopogonidae	6	X					
Asellidae	8	X	X	X			X
Talitridae	8	X	X	X	X		
Planorbidae	NS	X	X	X	X		X
Amnicola	8	X					
Physidae	8	X	X	X	X	X	X
Lymnaeidae	6	X	X				X
Sphaeriidae	8		X	X	X	X	X
Notonectidae	NS			X			
Elmidae	4			X			X
Chironomidae	6			X	X	X	X
Chironomidae (blood red)	8					X	
Oligochaeta	NS				X		X
Stratiomyidae	NS				X		X
Haliplidae	NS				X		
Cordulegastridae	3					X	
Hydrophilidae						X	
Helisoma	6					X	
Coenagrionidae	9						X
Belostomatidae	NS						X
Nepidae	NS						X
Culicidae	NS						X

The relative impairment of Baker and Overmeyer Ditch may be placed into context by comparing three of the mIBI metrics to data collected in Otter Creek in Vigo County, Indiana. The IDNR LARE staff suggested that Otter Creek may offer a reference for comparison because it appears to have good water quality and contains a high quality fish and mussel fauna (Wente, 1995). Otter Creek is also in close proximity to people living in Terre Haute. Table 11 displays the results of the comparison. Three of the macroinvertebrate metrics calculated during this study for Baker and Overmeyer Ditch are generally poor in comparison to the same metrics calculated in Otter Creek 1991 and 1994 studies. Most notably, no EPT individuals were collected in the Bruce Lake Watershed. The FBI scores from both Baker and Overmeyer Ditch are significantly higher (poorer) than that of Otter Creek.

TABLE 11. Comparison of three mIBI metrics for Baker Ditch, Overmeyer Ditch, and Otter Creek. Otter Creek was sampled by Wente of Lake Hart Research (Wente, 1995) as part of another LARE study in 1994 and by IDEM in 1991. Numbers represent averages of all available data.

Waterbody	EPT	EPT/Chiromonid	FBI
Baker Ditch	0.00	0.00	7.62
Overmeyer Ditch	0.00	0.00	7.24
Otter Creek	40.72	1.58	4.72

Although one would not expect to see large differences in the mIBI from June to October, scores for both sites on Overmeyer Ditch showed increases in October when compared to June. The mIBI score at Site 3 was increased significantly by 1.4 points. Although the exact reason for the increase cannot be known with certainty, three possible reasons exist. First, a spring-time stream or watershed disturbance (like tilling, replacement of a drainage tile(s), riparian area debrushing, etc.) may have affected the macroinvertebrate community present in the stream. Secondly, a lack of food resources may have limited the filter/scraper-type organisms that typically occupy the benthic zone in spring. Larger, particulate matter may have been available to stimulate the shredder-type species that are typical in the fall. Finally, the observation may simply be inherent, "normal" variation. The stream is a highly modified drainage-way where disturbance is normal, so it is reasonable to expect instability in the macroinvertebrate community structure as well.

Although poor water quality cannot be dismissed as a causative factor, Karr (1995) lists several other common causes of resource degradation: 1) altered supply of organic material for food and habitat from the riparian corridor; 2) sedimentation of substrate spaces causing a loss of habitat; 3) lack of coarse woody debris; 4) destruction of riparian vegetation and natural bank structure; 5) lack of deep pool areas; 6) altered abundance and distribution of pool-riffle-run complexes; 7) altered flow regime. These factors can also affect a stream's ability to support a healthy biological community including insects, shellfish, other invertebrates, amphibians, and fish.

Based on the habitat data, it is likely that Bruce Lake Watershed streams also suffer from many of the factors listed by Karr. Collectively, all three stream reaches received the lowest percentage of possible QHEI points in the pool, riffle, and substrate categories. Pool-riffle-run development was non-existent in any of the three study reaches. Substrate evaluations indicate that substrate type diversity was low (all muck/silt), silt cover was heavy, and embeddedness was extensive. Embedded substrates do not offer suitable habitat for stream insects or fish because silt-filled interstitial spaces cannot offer shelter for insects and small fish. These same interstitial spaces are also necessary for successful spawning of many fish species.

Macroinvertebrate and Habitat Correlation Analysis

Biological and habitat indices were analyzed for relationships that could provide additional insight into mechanisms governing impairment within the watershed. The mIBI and the QHEI cover score were found to be marginally statistically correlated for the spring sampling event (Figure 4). Just as would be expected, sites with better cover fostered healthier macroinvertebrate communities. No other relationships among indices or categories were found. One possible explanation for this lack of correlation is that these ditches are highly modified, artificial drainage ditches, and consequently might not reflect natural relationships among parameters of biological health and habitat quality.

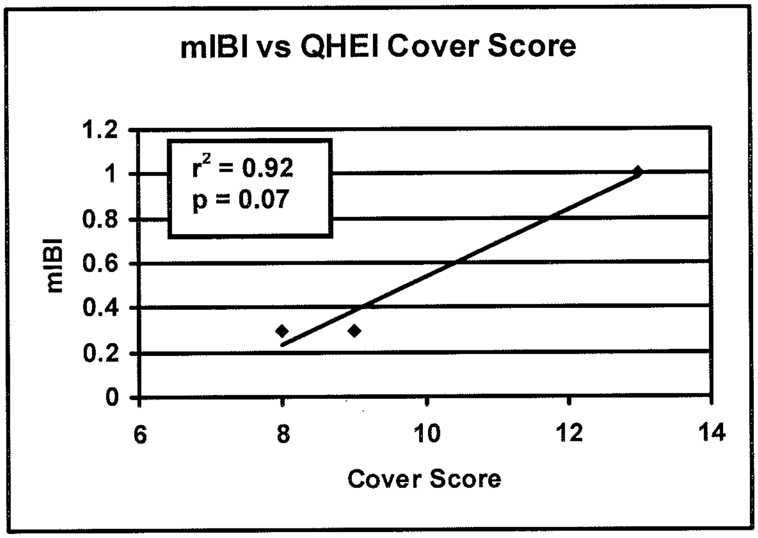

FIGURE 4. Statistically significant relationship between QHEI cover score and mIBI score during the spring sampling event.

SUMMARY AND RECOMMENDATIONS

In summary, the chemical water quality and biological health of Baker and Overmeyer Ditches indicate impairment and degradation. In fact, according to Indiana Department of Environmental Management (IDEM) 305(b) report assessment criteria (IDEM, 2000), Baker and Overmeyer Ditch are probably incapable at this time of supporting a "well-balanced, warm water aquatic community" (Indiana Administrative Code 2-1-3). Habitat quality (as scored using the QHEI) was also degraded and heavily influenced by agricultural drainage and maintenance activities. In fact, two of the three stream habitat characteristics found to be the most impaired (channel structure and pool presence) were also the most influential in explaining macroinvertebrate community integrity (i.e., explained the most variance in the mIBI).

Due to the limited scope of this study, only general recommendations can be proposed at this time. These prioritizations are simply guidelines based on conditions documented during this study. These conditions may change as land use or other watershed-level factors change.

1. Before implementing any planned BMPs near Lake Bruce ditches, coordinate projects with the county drainage board. Water quality will be extremely difficult to protect unless a sustainable drainage maintenance plan is created. The details of such a plan would need to be forged by the interested parties so that the plan meets the needs of all the parties. The Fulton County SWCD is encouraged to work closely with the county drainage board during and after the drainage project to develop techniques and implement BMPs that will prevent soil erosion and loss to the drainage-ways. Stream maintenance projects have definite implications for stream water quality and biological health. This issue must be addressed before the implementation of other water quality projects will be worth the money spent on them.
2. Discontinue the current monitoring project until the issues laid out in Recommendation 1 are addressed. Although the current study was targeted at characterizing baseline conditions in Bruce Lake tributaries, a ditch maintenance project as significant as the one planned for Baker and Overmeyer Ditches will alter conditions measured during the study. The dredging project will render data collected during this study much less useful for future comparisons.
3. Future monitoring efforts should utilize appropriate sampling techniques for the existing conditions in the Bruce Lake Watershed when a monitoring program is again undertaken. The mIBI required by the LARE program was designed and calibrated by IDEM for use in wadeable, riffle-type habitat that can be sampled with a kick net. The two sampling sites nearest Lake Bruce were stagnant. No riffles existed at any of the three sites, and samples had to be collected with a dip net. The mIBI is not well suited for evaluating bodies of water that are not streams. IDEM is currently developing a mIBI for use in lentic (standing) systems (Carol Newhouse, personal communication), and it is recommended that the lentic index be used in the future to assess benthic macroinvertebrate health at sites like those nearest the lake.
4. While focusing on Recommendation 1, extend management ideas to the watershed level. Although streamside localized BMPs are important, research conducted in Wisconsin shows that the biotic community mostly responds to large-scale watershed influences rather than local riparian land use changes (Weigel et al., 2000). Examples of working at

the watershed-level include coordinating with producers to implement nutrient, pesticide, tillage, and coordinated resource management plans. Large-scale reductions in agricultural non-point source pollution are necessary for stream health improvement (Osmond and Gale, 1995).

5. Provide information about streams within the Lake Bruce Watershed to local landowners. Landowners will be more likely to conserve and protect the creeks if they understand their value. The outreach program could include pointers on how landowners themselves can help protect the waterways. As taxpayers, landowners will be more likely to implement BMPs and work toward water quality protection if they understand that doing so may preclude or greatly reduce the need for expensive drainage maintenance projects.

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APPENDIX A

SITE PHOTOS

LAKE BRUCE WATERSHED LAND TREATMENT PROJECT AREA

FULTON COUNTY, INDIANA

Site 1: Baker Ditch at CR 75 North facing north.

Site 2: Overmeyer Ditch at CR 1125 West facing east.

Site 3: Overmeyer Ditch at CR 125 North facing north.

JFNA# 00-09-16

APPENDIX A: Macroinvertebrate Sampling Sites
Lake Bruce Macroinvertebrate Monitoring
Fulton County SWCD
Fulton County, Indiana

J.F. New & Associates, Inc.
708 Roosevelt Road
P.O. Box 243
Walkerton, IN 46574
Phone: 219-586-3400
FAX: 219-586-3446
Permitting • Delineations • Mitigation Design • Biological Inventories
Wetland and Prairie Nursery • Lake and Stream Enhancement
Natural Systems for Wastewater Treatment

APPENDIX B

DETAILED mIBI RESULTS AND BENCH SHEETS

LAKE BRUCE WATERSHED LAND TREATMENT PROJECT AREA

FULTON COUNTY, INDIANA

TABLE B1. Baker Ditch at CR 75 N (Site 1) multi-habitat macroinvertebrate results for the spring sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Odonata	Libellulidae	4		9	36	4.0
Hemiptera	Pleidae	8			0	8.0
Diptera	Ceratopogonidae	1		6	6	1.0
Diptera	Sciomyzidae	1			0	1.0
Diptera	Stratiomyidae	1			0	1.0
Amphipoda	Hyalella	50			0	**49.5**
Arthropoda	Asellidae	17		8	136	16.8
Mollusca	Helisoma	13		6	78	12.9
Mollusca	Amnicola	2		8	16	2.0
Mollusca	Physa	2		8	16	2.0
Mollusca	Stagnicola	2			0	2.0
		101	**0**		**7.38 HBI**	

TABLE B2. Baker Ditch at CR 75 N (Site 1) spring mIBI metrics.

		Metric Score
FBI	7.38	0
No. Taxa (family)	11	4
% Dominant Taxa	49.5	2
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**1.0**

TABLE B3. Overmeyer Ditch at CR 1125 W (Site 2) multi-habitat macroinvertebrate results for the spring sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Mollusca	Helisoma	60		6	360	**59.4**
Mollusca	Sphaeriidae	6		8	48	5.9
Diptera	Chironomidae	6		6	36	5.9
Hemiptera	Notonectidae	1			0	1.0
Hemiptera	Pleidae	1			0	1.0
Amphipoda	Hyalella	4			0	4.0
Isopoda	Asellidae	1		8	8	1.0
Diptera	Culicidae	1			0	1.0
Coleoptera	Elmidae	1		4	4	1.0
Mollusca	Physa	18		8	144	17.8
		101	**0**		**6.52 FBI**	

TABLE B4. Overmeyer Ditch at CR 1125 W (Site 2) spring mIBI metrics.

		Metric Score
FBI	6.52	0
No. Taxa (family)	10	2
% Dominant Taxa	59.4	0
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**0.3**

TABLE B5. Overmeyer Ditch at CR 125 N (Site 3) multi-habitat macroinvertebrate results for the spring sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Diptera	Chironomidae	37		6	222	**35.9**
Diptera	Chironomidae	13		8 (blood red)	104	12.6
Mollusca	Physa	22		8	176	21.4
Mollusca	Helisoma	18		6	108	17.5
Odonata	Cordulidae	3		4	12	2.9
Coleoptera	Hydrophilidae	2			0	1.9
Coleoptera	Sphaeriidae	7		8	0	6.8
		103	**0**		**6.70 FBI**	

TABLE B6. Overmeyer Ditch at CR 125 N (Site 3) spring mIBI metrics.

		Metric Score
FBI	6.70	0
No. Taxa (family)	7	0
% Dominant Taxa	48.5	2
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**0.3**

TABLE B7. Baker Ditch at CR 75 N (Site 1) multi-habitat macroinvertebrate results for the fall sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Isopoda	Asellidae	29		8	232	24.4
Isopoda	Planorbidae	31				**26.0**
Isopoda	Sphaeriidae	19		8	152	16.0
Isopoda	Lymnacidae	7		6	42	5.9
Isopoda	Physidae	3		8	24	2.5
Amphipoda	Talitridae	29		8	232	24.4
Odonata	Libellulidae	1		9	9	0.8
		119	**0**		**7.85 FBI**	

TABLE B8. Baker Ditch at CR 75 N (Site 1) fall mIBI metrics.

		Metric Score
FBI	7.85	0
No. Taxa (family)	7	0
% Dominant Taxa	26	6
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**1.0**

TABLE B9. Overmeyer Ditch at CR 1125 W (Site 2) multi-habitat macroinvertebrate results for the fall sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Isopoda	Sphaeriidae	21		8	168	21
Isopoda	Planorbidae	54				**54**
Isopoda	Physidae	15		8	120	15
Diptera	Chironomidae	1		6	6	1
Amphipoda	Talitridae	3		8	24	3
Diptera	Stratiomyidae	1				1
Platyhelminthes	Oligochaeta	3				3
Coleoptera	Haliplidae	2				2
		100	**0**		**7.95 FBI**	

TABLE B10. Overmeyer Ditch at CR 1125 W (Site 2) fall mIBI metrics.

		Metric Score
FBI	7.95	0
No. Taxa (family)	8	2
% Dominant Taxa	54	2
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**0.7**

TABLE B11. Overmeyer Ditch at CR 125 N (Site 3) multi-habitat macroinvertebrate results for the fall sampling.

Order	Family	#	EPT	Tolerance (t)	# • t	%
Isopoda	Asellidae	12		8	96	12
Isopoda	Planorbidae	12				12
Isopoda	Physidae	6		8	48	6
Isopoda	Sphaeridae	8		8	64	8
Diptera	Chironomidae	10		6	60	10
Isopoda	Lymnacidae	4		6	24	4
Platyhelmenthes	Oligochaeta	18				18
Coleoptera	Elmidae	2		4	8	2
Diptera	Culicidae	1				1
Hemiptera	Belostomidae	1				1
Hemiptera	Nepidae	1				1
Odonata	Coenagrionidae	23		9	207	**23**
Diptera	Stratiomyidae	22				22
		100	**0**		**7.77 FBI**	

TABLE B12. Overmeyer Ditch at CR 125 N (Site 3) fall mIBI metrics.

		Metric Score
FBI	7.77	0
No. Taxa (family)	14	4
% Dominant Taxa	23	6
EPT Index	0	0
EPT Count/Total Count	0	0
EPT Abun./Chir. Abun.	0	0
mIBI Score		**1.7**

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 1 SITE: Baker Ditch at CR 75N COUNTY: Fulton CREW CHIEF:
LOCATION: downstream of road crossing HYDROLOGIC UNIT: 05120106060080 DATE OF COLLECTION: 26 JUN 01
ECOREGION: IASNRI: SORTER: SZ LABEL CHECK: ✓

EPHEMEROPTERA
SIPHLONURIDAE (7) ___ METRETOPODIDAE (2) ___ BAETIDAE (4) ___ BAETISCIDAE (3) ___ HEPTAGENIIDAE (4) ___
EPHEMERELLIDAE (1) ___ TRICORYTHIDAE (4) ___ CAENIDAE (7) ___ OLIGONEURIIDAE (2) ___ LEPTOPHLEBIIDAE (2) ___
POTAMANTHIDAE (4) ___ EPHEMERIDAE (4) ___ POLYMITARCYIDAE (2) ___

ODONATA **ZYGOPTERA**
CORDULEGASTRIDAE (3) ___ GOMPHIDAE (1) ___ AESHNIDAE (3) ___ MACROMIIDAE (3) ___ CORDULIIDAE (3) ___
LIBELLULIDAE (9) 4 CALOPTERYGIDAE (5) ___ LESTIDAE (9) ___ COENAGRIONIDAE (9) ___

PLECOPTERA
PTERONARCYIDAE (0) ___ TAENIOPTERYGIDAE (2) ___ NEMOURIDAE (2) ___ LEUCTRIDAE (0) ___ CAPNIIDAE (1) ___
PERLIDAE (1) ___ PERLODIDAE (2) ___ CHLOROPERLIDAE (1) ___

HEMIPTERA
MACROVELIIDAE () ___ VELIIDAE () ___ GERRIDAE () ___ BELOSTOMATIDAE () ___ NEPIDAE () ___ CORIXIDAE () ___
NOTONECTIDAE () ___ PLEIDAE () 8 SALDIDAE () ___ HEBRIDAE () ___ NAUCORIDAE () ___ MESOVELIIDAE () ___

MEGALOPTERA SIALIDAE (4) ___ CORYDALIDAE (1) ___ SISYRIDAE () ___

TRICHOPTERA
PHILOPOTAMIDAE (3) ___ PSYCHOMYIIDAE (2) ___ POLYCENTROPODIDAE (6) ___ HYDROPSYCHIDAE (4) ___
RHYACOPHILIDAE (0) ___ GLOSSOSOMATIDAE (0) ___ HYDROPTILIDAE (4) ___ PHRYGANEIDAE (4) ___
BRACHYCENTRIDAE (1) ___ LEPIDOSTOMATIDAE (1) ___ HELICOPSYCHIDAE (3) ___ SERICOSTOMATIDAE (3) ___
ODONTOCERIDAE (0) ___ MOLANNIDAE (6) ___ LIMNEPHILIDAE (4) ___ LEPTOCERIDAE (4) ___

LEPIDOPTERA PYRALIDAE (5) ___ NOCTUIDAE () ___

COLEOPTERA
GYRINIDAE() ___ HALIPLIDAE() ___ DYTISCIDAE() ___ HYDROPHILIDAE() ___ PSEPHENIDAE (4) ___ DRYOPIDAE(5) ___ ELMIDAE(4) ___
SCIRTIDAE () ___ STAPHYLINIDAE () ___ CHRYSOMELIDAE () ___ CURCULIONIDAE () ___ HYDRAENIDAE () ___

DIPTERA
BLEPHARICERIDAE (0) ___ TIPULIDAE (3) ___ PSYCHODIDAE (10) ___ TABANIDAE (6) ___ ATHERICIDAE (2) ___
CHIRONOMIDAE(blood red)(8) ___ CHIRONOMIDAE(all other)(6) ___ SYRPHIDAE (10) ___ EPHYDRIDAE (6) ___ MUSCIDAE (6) ___
DOLICHOPODIDAE (4) ___ EMPIDIDAE (6) ___ CERATOPOGONIDAE (6) 1 SIMULIIDAE (6) ___ CHAOBORIDAE () ___

COLLEMBOLA ISOTOMIDAE () ___ PODURIDAE () ___ SMINTHURIDAE () ___ ENTOMOBRYIDAE () ___

OTHER ARTHROPODA
ACARI (4) ___ ASELLIDAE (8) 17 GAMMARIDAE (4) ___ TALITRIDAE (8) 50 ASTACIDAE (6) ___

MOLLUSCA
GASTROPODA FERRISSIA (6) ___ HELISOMA (6) ___ LYMNAEA (6) 2 AMNICOLA (8) 2 PLEUROCERIDAE () ___ VIVIPARIDAE () ___
BITHYNIA (8) ___ GYRAULUS (8) ___ PHYSA (8) 2 PLANORBIDAE () 13 HYDROBIIDAE () ___ ANCYLIDAE () ___
PELECYPODA SPHAERIIDAE (8) ___ CORBICULA () ___ DRIESSENIA () ___

PLATYHELMINTHES TURBELLARIA (4) ___ ANNELIDA () ___ OLIGOCHAETA () ___ TUBIFICIDAE () ___ NAIDIDAE () ___
HIRUDINEA () ___ HELOBDELLA (10) ___ BRANCHIOBDELLIDA () ___ ERPOBDELLIDAE () ___ NEMATODA () ___

NUMBER OF VIALS FORWARDED: 11 PRELIMINARY NUMBER OF TAXA: 11 NUMBER OF INDIVIDUALS: ___
HBI: 7.93 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 0
% DOMINANT TAXON: 49.5 EPT INDEX: 0 EPT/TOTAL COUNT: 0
PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 2 JUL 01 COUNTS & CALCULATION CHECK: CS SZ

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 2 ____ SITE: Overmeyer Ditch at CR 1125 COUNTY: Fulton CREW CHIEF:
LOCATION: upstream of road crossing HYDROLOGIC UNIT: 05120106060080 DATE OF COLLECTION: 26JUN01
ECOREGION: IASNRI: SORTER: SZ LABEL CHECK: ✓

EPHEMEROPTERA

SIPHLONURIDAE (7) ____ METRETOPODIDAE (2) ____ BAETIDAE (4) ____ BAETISCIDAE (3) ____ HEPTAGENIIDAE (4) ____
EPHEMERELLIDAE (1) ____ TRICORYTHIDAE (4) ____ CAENIDAE (7) ____ OLIGONEURIIDAE (2) ____ LEPTOPHLEBIIDAE (2) ____
POTAMANTHIDAE (4) ____ EPHEMERIDAE (4) ____ POLYMITARCYIDAE (2) ____

ODONATA **ZYGOPTERA**

CORDULEGASTRIDAE (3) ____ GOMPHIDAE (1) ____ AESHNIDAE (3) ____ MACROMIIDAE (3) ____ CORDULIIDAE (3) ____
LIBELLULIDAE (9) ____ CALOPTERYGIDAE (5) ____ LESTIDAE (9) ____ COENAGRIONIDAE (9) ____

PLECOPTERA

PTERONARCYIDAE (0) ____ TAENIOPTERYGIDAE (2) ____ NEMOURIDAE (2) ____ LEUCTRIDAE (0) ____ CAPNIIDAE (1) ____
PERLIDAE (1) ____ PERLODIDAE (2) ____ CHLOROPERLIDAE (1) ____

HEMIPTERA

MACROVELIIDAE () ____ VELIIDAE () ____ GERRIDAE () ____ BELOSTOMATIDAE () ____ NEPIDAE () ____ CORIXIDAE () ____
NOTONECTIDAE () 1 PLEIDAE () 1 SALDIDAE () ____ HEBRIDAE () ____ NAUCORIDAE () ____ MESOVELIIDAE () ____

MEGALOPTERA SIALIDAE (4) ____ CORYDALIDAE (1) ____ SISYRIDAE () ____

TRICHOPTERA

PHILOPOTAMIDAE (3) ____ PSYCHOMYIIDAE (2) ____ POLYCENTROPODIDAE (6) ____ HYDROPSYCHIDAE (4) ____
RHYACOPHILIDAE (0) ____ GLOSSOSOMATIDAE (0) ____ HYDROPTILIDAE (4) ____ PHRYGANEIDAE (4) ____
BRACHYCENTRIDAE (1) ____ LEPIDOSTOMATIDAE (1) ____ HELICOPSYCHIDAE (3) ____ SERICOSTOMATIDAE (3) ____
ODONTOCERIDAE (0) ____ MOLANNIDAE (6) ____ LIMNEPHILIDAE (4) ____ LEPTOCERIDAE (4) ____

LEPIDOPTERA PYRALIDAE (5) ____ NOCTUIDAE () ____

COLEOPTERA

GYRINIDAE() ____ HALIPLIDAE() ____ DYTISCIDAE() ____ HYDROPHILIDAE() ____ PSEPHENIDAE (4) ____ DRYOPIDAE(5) ____ ELMIDAE(4) 1
SCIRTIDAE () ____ STAPHYLINIDAE () ____ CHRYSOMELIDAE () ____ CURCULIONIDAE () ____ HYDRAENIDAE () ____

DIPTERA

BLEPHARICERIDAE (0) ____ TIPULIDAE (3) ____ PSYCHODIDAE (10) ____ TABANIDAE (6) ____ ATHERICIDAE (2) ____
CHIRONOMIDAE(blood red)(8) ____ CHIRONOMIDAE(all other)(6) 6 SYRPHIDAE (10) ____ EPHYDRIDAE (6) ____ MUSCIDAE (6) ____
DOLICHOPODIDAE (4) ____ EMPIDIDAE (6) ____ CERATOPOGONIDAE (6) ____ SIMULIIDAE (6) ____ CHAOBORIDAE () ____

COLLEMBOLA ISOTOMIDAE () ____ PODURIDAE () ____ SMINTHURIDAE () ____ ENTOMOBRYIDAE () ____

OTHER ARTHROPODA

ACARI (4) ____ ASELLIDAE (8) 1 GAMMARIDAE (4) ____ TALITRIDAE (8) 4 ASTACIDAE (6) ____

MOLLUSCA

GASTROPODA FERRISSIA (6) ____ HELISOMA (6) ____ LYMNAEA (6) ____ AMNICOLA (8) ____ PLEUROCERIDAE () ____ VIVIPARIDAE () ____
BITHYNIA (8) ____ GYRAULUS (8) ____ PHYSA (8) 18 PLANORBIDAE () 60 HYDROBIIDAE () ____ ANCYLIDAE () ____
PELECYPODA SPHAERIIDAE (8) 6 CORBICULA () ____ DRIESSENIA () ____

PLATYHELMINTHES TURBELLARIA (4) ____ ANNELIDA () ____ OLIGOCHAETA () ____ TUBIFICIDAE () ____ NAIDIDAE () ____
HIRUDINEA () ____ HELOBDELLA (10) ____ BRANCHIOBDELLIDA () ____ ERPOBDELLIDAE () ____ NEMATODA () ____

NUMBER OF VIALS FORWARDED: 10 PRELIMINARY NUMBER OF TAXA: 10 NUMBER OF INDIVIDUALS: 101

HBI: 7.56 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 6

% DOMINANT TAXON: 59 EPT INDEX: 0 EPT/TOTAL COUNT: 0

PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 2JUL101 COUNTS & CALCULATION CHECK: CS SZ

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 3 ____ SITE: Overmeyer Ditch at CR 125 N COUNTY: Fulton CREW CHIEF:
LOCATION: downstream of road crossing HYDROLOGIC UNIT: 05120106060080 DATE OF COLLECTION: 26 JUN 01
ECOREGION: IASNRI: SORTER: SZ LABEL CHECK: ✓

EPHEMEROPTERA
SIPHLONURIDAE (7) ____ METRETOPODIDAE (2) ____ BAETIDAE (4) ____ BAETISCIDAE (3) ____ HEPTAGENIIDAE (4) ____
EPHEMERELLIDAE (1) ____ TRICORYTHIDAE (4) ____ CAENIDAE (7) ____ OLIGONEURIIDAE (2) ____ LEPTOPHLEBIIDAE (2) ____
POTAMANTHIDAE (4) ____ EPHEMERIDAE (4) ____ POLYMITARCYIDAE (2) ____

ODONATA **ZYGOPTERA**
CORDULEGASTRIDAE (3) ____ GOMPHIDAE (1) ____ AESHNIDAE (3) ____ MACROMIIDAE (3) ____ CORDULIIDAE (3) 4
LIBELLULIDAE (9) ____ CALOPTERYGIDAE (5) ____ LESTIDAE (9) ____ COENAGRIONIDAE (9) ____

PLECOPTERA
PTERONARCYIDAE (0) ____ TAENIOPTERYGIDAE (2) ____ NEMOURIDAE (2) ____ LEUCTRIDAE (0) ____ CAPNIIDAE (1) ____
PERLIDAE (1) ____ PERLODIDAE (2) ____ CHLOROPERLIDAE (1) ____

HEMIPTERA
MACROVELIIDAE () ____ VELIIDAE () ____ GERRIDAE () ____ BELOSTOMATIDAE () ____ NEPIDAE () ____ CORIXIDAE () ____
NOTONECTIDAE () ____ PLEIDAE () ____ SALDIDAE () ____ HEBRIDAE () ____ NAUCORIDAE () ____ MESOVELIIDAE () ____

MEGALOPTERA SIALIDAE (4) ____ CORYDALIDAE (1) ____ SISYRIDAE () ____

TRICHOPTERA
PHILOPOTAMIDAE (3) ____ PSYCHOMYIIDAE (2) ____ POLYCENTROPODIDAE (6) ____ HYDROPSYCHIDAE (4) ____
RHYACOPHILIDAE (0) ____ GLOSSOSOMATIDAE (0) ____ HYDROPTILIDAE (4) ____ PHRYGANEIDAE (4) ____
BRACHYCENTRIDAE (1) ____ LEPIDOSTOMATIDAE (1) ____ HELICOPSYCHIDAE (3) ____ SERICOSTOMATIDAE (3) ____
ODONTOCERIDAE (0) ____ MOLANNIDAE (6) ____ LIMNEPHILIDAE (4) ____ LEPTOCERIDAE (4) ____

LEPIDOPTERA PYRALIDAE (5) ____ NOCTUIDAE () ____

COLEOPTERA
GYRINIDAE() ____ HALIPLIDAE() ____ DYTISCIDAE() ____ HYDROPHILIDAE() 2 PSEPHENIDAE (4) ____ DRYOPIDAE(5) ____ ELMIDAE(4) ____
SCIRTIDAE () ____ STAPHYLINIDAE () ____ CHRYSOMELIDAE () ____ CURCULIONIDAE () ____ HYDRAENIDAE () ____

DIPTERA
BLEPHARICERIDAE (0) ____ TIPULIDAE (3) ____ PSYCHODIDAE (10) ____ TABANIDAE (6) ____ ATHERICIDAE (2) ____
CHIRONOMIDAE(blood red)(8) 13 CHIRONOMIDAE(all other)(6) 37 SYRPHIDAE (10) ____ EPHYDRIDAE (6) ____ MUSCIDAE (6) ____
DOLICHOPODIDAE (4) ____ EMPIDIDAE (6) ____ CERATOPOGONIDAE (6) ____ SIMULIIDAE (6) ____ CHAOBORIDAE () ____

COLLEMBOLA ISOTOMIDAE () ____ PODURIDAE () ____ SMINTHURIDAE () ____ ENTOMOBRYIDAE () ____

OTHER ARTHROPODA
ACARI (4) ____ ASELLIDAE (8) ____ GAMMARIDAE (4) ____ TALITRIDAE (8) ____ ASTACIDAE (6) ____

MOLLUSCA
GASTROPODA FERRISSIA (6) ____ HELISOMA (6) 18 LYMNAEA (6) ____ AMNICOLA (8) ____ PLEUROCERIDAE () ____ VIVIPARIDAE () ____
BITHYNIA (8) ____ GYRAULUS (8) ____ PHYSA (8) 22 PLANORBIDAE () ____ HYDROBIIDAE () ____ ANCYLIDAE () ____
PELECYPODA SPHAERIIDAE (8) 7 CORBICULA () ____ DRIESSENIA () ____

PLATYHELMINTHES TURBELLARIA (4) ____ ANNELIDA () ____ OLIGOCHAETA () ____ TUBIFICIDAE () ____ NAIDIDAE () ____
HIRUDINEA () ____ HELOBDELLA (10) ____ BRANCHIOBDELLIDA () ____ ERPOBDELLIDAE () ____ NEMATODA () ____

NUMBER OF VIALS FORWARDED: 6 PRELIMINARY NUMBER OF TAXA: 7 NUMBER OF INDIVIDUALS: 103
HBI: 6.7 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 50
% DOMINANT TAXON: 48.5 EPT INDEX: 0 EPT/TOTAL COUNT: 0
PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 2 JUL 01 COUNTS & CALCULATION CHECK: CS SZ

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 1 ____ SITE: Baker Ditch at COUNTY: Fulton CREW CHIEF:
LOCATION: downstream of CR 75 N road crossing HYDROLOGIC UNIT: 0512010606-0080 DATE OF COLLECTION: 10/31/01
ECOREGION: IASNRI: SORTER: SZ LABEL CHECK: ✓

EPHEMEROPTERA
SIPHLONURIDAE (7) ____ METRETOPODIDAE (2) ____ BAETIDAE (4) ____ BAETISCIDAE (3) ____ HEPTAGENIIDAE (4) ____
EPHEMERELLIDAE (1) ____ TRICORYTHIDAE (4) ____ CAENIDAE (7) ____ OLIGONEURIIDAE (2) ____ LEPTOPHLEBIIDAE (2) ____
POTAMANTHIDAE (4) ____ EPHEMERIDAE (4) ____ POLYMITARCYIDAE (2) ____

ODONATA **ZYGOPTERA**
CORDULEGASTRIDAE (3) ____ GOMPHIDAE (1) ____ AESHNIDAE (3) ____ MACROMIIDAE (3) ____ CORDULIIDAE (3) ____
LIBELLULIDAE (9) 1 CALOPTERYGIDAE (5) ____ LESTIDAE (9) ____ COENAGRIONIDAE (9) ____

PLECOPTERA
PTERONARCYIDAE (0) ____ TAENIOPTERYGIDAE (2) ____ NEMOURIDAE (2) ____ LEUCTRIDAE (0) ____ CAPNIIDAE (1) ____
PERLIDAE (1) ____ PERLODIDAE (2) ____ CHLOROPERLIDAE (1) ____

HEMIPTERA
MACROVELIIDAE () ____ VELIIDAE () ____ GERRIDAE () ____ BELOSTOMATIDAE () ____ NEPIDAE () ____ CORIXIDAE () ____
NOTONECTIDAE () ____ PLEIDAE () ____ SALDIDAE () ____ HEBRIDAE () ____ NAUCORIDAE () ____ MESOVELIIDAE () ____

MEGALOPTERA SIALIDAE (4) ____ CORYDALIDAE (1) ____ SISYRIDAE () ____

TRICHOPTERA
PHILOPOTAMIDAE (3) ____ PSYCHOMYIIDAE (2) ____ POLYCENTROPODIDAE (6) ____ HYDROPSYCHIDAE (4) ____
RHYACOPHILIDAE (0) ____ GLOSSOSOMATIDAE (0) ____ HYDROPTILIDAE (4) ____ PHRYGANEIDAE (4) ____
BRACHYCENTRIDAE (1) ____ LEPIDOSTOMATIDAE (1) ____ HELICOPSYCHIDAE (3) ____ SERICOSTOMATIDAE (3) ____
ODONTOCERIDAE (0) ____ MOLANNIDAE (6) ____ LIMNEPHILIDAE (4) ____ LEPTOCERIDAE (4) ____

LEPIDOPTERA PYRALIDAE (5) ____ NOCTUIDAE () ____

COLEOPTERA
GYRINIDAE() ____ HALIPLIDAE() ____ DYTISCIDAE() ____ HYDROPHILIDAE() ____ PSEPHENIDAE (4) ____ DRYOPIDAE(5) ____ ELMIDAE(4) ____
SCIRTIDAE () ____ STAPHYLINIDAE () ____ CHRYSOMELIDAE () ____ CURCULIONIDAE () ____ HYDRAENIDAE () ____

DIPTERA
BLEPHARICERIDAE (0) ____ TIPULIDAE (3) ____ PSYCHODIDAE (10) ____ TABANIDAE (6) ____ ATHERICIDAE (2) ____
CHIRONOMIDAE(blood red)(8) ____ CHIRONOMIDAE(all other)(6) ____ SYRPHIDAE (10) ____ EPHYDRIDAE (6) ____ MUSCIDAE (6) ____
DOLICHOPODIDAE (4) ____ EMPIDIDAE (6) ____ CERATOPOGONIDAE (6) ____ SIMULIIDAE (6) ____ CHAOBORIDAE () ____

COLLEMBOLA ISOTOMIDAE () ____ PODURIDAE () ____ SMINTHURIDAE () ____ ENTOMOBRYIDAE () ____

OTHER ARTHROPODA
ACARI (4) ____ ASELLIDAE (8) 29 GAMMARIDAE (4) ____ TALITRIDAE (8) 29 ASTACIDAE (6) ____

MOLLUSCA
GASTROPODA FERRISSIA (6) ____ HELISOMA (6) ____ LYMNAEA (6) 7 AMNICOLA (8) ____ PLEUROCERIDAE () ____ VIVIPARIDAE () ____
BITHYNIA (8) ____ GYRAULUS (8) ____ PHYSA (8) 3 PLANORBIDAE () 31 HYDROBIIDAE () ____ ANCYLIDAE () ____
PELECYPODA SPHAERIIDAE (8) 19 CORBICULA () ____ DRIESSENIA () ____

PLATYHELMINTHES TURBELLARIA (4) ____ ANNELIDA () ____ OLIGOCHAETA () ____ TUBIFICIDAE () ____ NAIDIDAE () ____
HIRUDINEA () ____ HELOBDELLA (10) ____ BRANCHIOBDELLIDA () ____ ERPOBDELLIDAE () ____ NEMATODA () ____

NUMBER OF VIALS FORWARDED: 7 PRELIMINARY NUMBER OF TAXA: 7 NUMBER OF INDIVIDUALS: 119
HBI: 7.85 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 0
% DOMINANT TAXON: 26 EPT INDEX: 0 EPT/TOTAL COUNT: 0
PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 11/1/01 COUNTS & CALCULATION CHECK: SZ CS

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 2 ____ SITE: Overmeyer Ditch at CR 1125 COUNTY: Fulton CREW CHIEF:

LOCATION: upstream of road crossing HYDROLOGIC UNIT: 0512010606-0080 DATE OF COLLECTION: 10/31/01

ECOREGION: IASNRI: SORTER: SZ LABEL CHECK: ✓

EPHEMEROPTERA

SIPHLONURIDAE (7) ____ METRETOPODIDAE (2) ____ BAETIDAE (4) ____ BAETISCIDAE (3) ____ HEPTAGENIIDAE (4) ____
EPHEMERELLIDAE (1) ____ TRICORYTHIDAE (4) ____ CAENIDAE (7) ____ OLIGONEURIIDAE (2) ____ LEPTOPHLEBIIDAE (2) ____
POTAMANTHIDAE (4) ____ EPHEMERIDAE (4) ____ POLYMITARCYIDAE (2) ____

ODONATA **ZYGOPTERA**

CORDULEGASTRIDAE (3) ____ GOMPHIDAE (1) ____ AESHNIDAE (3) ____ MACROMIIDAE (3) ____ CORDULIIDAE (3) ____
LIBELLULIDAE (9) ____ CALOPTERYGIDAE (5) ____ LESTIDAE (9) ____ COENAGRIONIDAE (9) ____

PLECOPTERA

PTERONARCYIDAE (0) ____ TAENIOPTERYGIDAE (2) ____ NEMOURIDAE (2) ____ LEUCTRIDAE (0) ____ CAPNIIDAE (1) ____
PERLIDAE (1) ____ PERLODIDAE (2) ____ CHLOROPERLIDAE (1) ____

HEMIPTERA

MACROVELIIDAE () ____ VELIIDAE () ____ GERRIDAE () ____ BELOSTOMATIDAE () ____ NEPIDAE () ____ CORIXIDAE () ____
NOTONECTIDAE () ____ PLEIDAE () ____ SALDIDAE () ____ HEBRIDAE () ____ NAUCORIDAE () ____ MESOVELIIDAE () ____

MEGALOPTERA SIALIDAE (4) ____ CORYDALIDAE (1) ____ SISYRIDAE () ____

TRICHOPTERA

PHILOPOTAMIDAE (3) ____ PSYCHOMYIIDAE (2) ____ POLYCENTROPODIDAE (6) ____ HYDROPSYCHIDAE (4) ____
RHYACOPHILIDAE (0) ____ GLOSSOSOMATIDAE (0) ____ HYDROPTILIDAE (4) ____ PHRYGANEIDAE (4) ____
BRACHYCENTRIDAE (1) ____ LEPIDOSTOMATIDAE (1) ____ HELICOPSYCHIDAE (3) ____ SERICOSTOMATIDAE (3) ____
ODONTOCERIDAE (0) ____ MOLANNIDAE (6) ____ LIMNEPHILIDAE (4) ____ LEPTOCERIDAE (4) ____

LEPIDOPTERA PYRALIDAE (5) ____ NOCTUIDAE () ____

COLEOPTERA

GYRINIDAE() ____ HALIPLIDAE() 2 DYTISCIDAE() ____ HYDROPHILIDAE() ____ PSEPHENIDAE (4) ____ DRYOPIDAE(5) ____ ELMIDAE(4) ____
SCIRTIDAE () ____ STAPHYLINIDAE () ____ CHRYSOMELIDAE () ____ CURCULIONIDAE () ____ HYDRAENIDAE () ____

DIPTERA

BLEPHARICERIDAE (0) ____ TIPULIDAE (3) ____ PSYCHODIDAE (10) ____ TABANIDAE (6) ____ ATHERICIDAE (2) ____
CHIRONOMIDAE(blood red)(8) ____ CHIRONOMIDAE(all other)(6) 1 SYRPHIDAE (10) ____ EPHYDRIDAE (6) ____ MUSCIDAE (6) ____
DOLICHOPODIDAE (4) ____ EMPIDIDAE (6) ____ CERATOPOGONIDAE (6) ____ SIMULIIDAE (6) ____ CHAOBORIDAE () ____

COLLEMBOLA ISOTOMIDAE () ____ PODURIDAE () ____ SMINTHURIDAE () ____ ENTOMOBRYIDAE () ____

OTHER ARTHROPODA

ACARI (4) ____ ASELLIDAE (8) ____ GAMMARIDAE (4) ____ TALITRIDAE (8) 3 ASTACIDAE (6) ____

MOLLUSCA

GASTROPODA FERRISSIA (6) ____ HELISOMA (6) ____ LYMNAEA (6) ____ AMNICOLA (8) ____ PLEUROCERIDAE () ____ VIVIPARIDAE () ____
BITHYNIA (8) ____ GYRAULUS (8) ____ PHYSA (8) 15 PLANORBIDAE () 54 HYDROBIIDAE () ____ ANCYLIDAE () ____

PELECYPODA SPHAERIIDAE (8) 21 CORBICULA () ____ DRIESSENIA () ____

PLATYHELMINTHES TURBELLARIA (4) ____ ANNELIDA () ____ OLIGOCHAETA () 3 TUBIFICIDAE () ____ NAIDIDAE () ____
HIRUDINEA () ____ HELOBDELLA (10) ____ BRANCHIOBDELLIDA () ____ ERPOBDELLIDAE () ____ NEMATODA () ____

NUMBER OF VIALS FORWARDED: 8 PRELIMINARY NUMBER OF TAXA: 8 NUMBER OF INDIVIDUALS: 100

HBI: 7.95 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 1

% DOMINANT TAXON: 54 EPT INDEX: 0 EPT/TOTAL COUNT: 0

PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 11/1/01 COUNTS & CALCULATION CHECK: SZ CS

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OWM - BIOLOGICAL STUDIES
BENTHIC MACROINVERTEBRATE BENCH SHEET
PHASE 1 TAXONOMY

SAMPLE NUMBER: 3 SITE: Overmeyer Ditch COUNTY: Fulton CREW CHIEF:
LOCATION: downstream of road crossing at CR 125 N HYDROLOGIC UNIT: 0512010606-0080 DATE OF COLLECTION: 10/31/01
ECOREGION: IDSNRI: SORTER: LABEL CHECK: ✓

EPHEMEROPTERA
SIPHLONURIDAE (7) ___ METRETOPODIDAE (2) ___ BAETIDAE (4) ___ BAETISCIDAE (3) ___ HEPTAGENIIDAE (4) ___
EPHEMERELLIDAE (1) ___ TRICORYTHIDAE (4) ___ CAENIDAE (7) ___ OLIGONEURIIDAE (2) ___ LEPTOPHLEBIIDAE (2) ___
POTAMANTHIDAE (4) ___ EPHEMERIDAE (4) ___ POLYMITARCYIDAE (2) ___

ODONATA **ZYGOPTERA**
CORDULEGASTRIDAE (3) ___ GOMPHIDAE (1) ___ AESHNIDAE (3) ___ MACROMIIDAE (3) ___ CORDULIIDAE (3) ___
LIBELLULIDAE (9) ___ CALOPTERYGIDAE (5) ___ LESTIDAE (9) ___ COENAGRIONIDAE (9) 23

PLECOPTERA
PTERONARCYIDAE (0) ___ TAENIOPTERYGIDAE (2) ___ NEMOURIDAE (2) ___ LEUCTRIDAE (0) ___ CAPNIIDAE (1) ___
PERLIDAE (1) ___ PERLODIDAE (2) ___ CHLOROPERLIDAE (1) ___

HEMIPTERA
MACROVELIIDAE () ___ VELIIDAE () ___ GERRIDAE () ___ BELOSTOMATIDAE () 1 NEPIDAE () 1 CORIXIDAE () ___
NOTONECTIDAE () ___ PLEIDAE () ___ SALDIDAE () ___ HEBRIDAE () ___ NAUCORIDAE () ___ MESOVELIIDAE () ___

MEGALOPTERA SIALIDAE (4) ___ CORYDALIDAE (1) ___ SISYRIDAE () ___

TRICHOPTERA
PHILOPOTAMIDAE (3) ___ PSYCHOMYIIDAE (2) ___ POLYCENTROPODIDAE (6) ___ HYDROPSYCHIDAE (4) ___
RHYACOPHILIDAE (0) ___ GLOSSOSOMATIDAE (0) ___ HYDROPTILIDAE (4) ___ PHRYGANEIDAE (4) ___
BRACHYCENTRIDAE (1) ___ LEPIDOSTOMATIDAE (1) ___ HELICOPSYCHIDAE (3) ___ SERICOSTOMATIDAE (3) ___
ODONTOCERIDAE (0) ___ MOLANNIDAE (6) ___ LIMNEPHILIDAE (4) ___ LEPTOCERIDAE (4) ___

LEPIDOPTERA PYRALIDAE (5) ___ NOCTUIDAE () ___

COLEOPTERA
GYRINIDAE() ___ HALIPLIDAE() ___ DYTISCIDAE() ___ HYDROPHILIDAE() ___ PSEPHENIDAE (4) ___ DRYOPIDAE(5) ___ ELMIDAE(4) 2
SCIRTIDAE () ___ STAPHYLINIDAE () ___ CHRYSOMELIDAE () ___ CURCULIONIDAE () ___ HYDRAENIDAE () ___

DIPTERA
BLEPHARICERIDAE (0) ___ TIPULIDAE (3) ___ PSYCHODIDAE (10) ___ TABANIDAE (6) ___ ATHERICIDAE (2) ___
CHIRONOMIDAE(blood red)(8) ___ CHIRONOMIDAE(all other)(6) 10 SYRPHIDAE (10) ___ EPHYDRIDAE (6) ___ MUSCIDAE (6) ___
DOLICHOPODIDAE (4) ___ EMPIDIDAE (6) ___ CERATOPOGONIDAE (6) ___ SIMULIIDAE (6) ___ CHAOBORIDAE () ___

COLLEMBOLA ISOTOMIDAE () ___ PODURIDAE () ___ SMINTHURIDAE () ___ ENTOMOBRYIDAE () ___

OTHER ARTHROPODA
ACARI (4) ___ ASELLIDAE (8) 12 GAMMARIDAE (4) ___ TALITRIDAE (8) ___ ASTACIDAE (6) ___

MOLLUSCA
GASTROPODA FERRISSIA (6) ___ HELISOMA (6) 1 LYMNAEA (6) 4 AMNICOLA (8) ___ PLEUROCERIDAE () ___ VIVIPARIDAE () ___
BITHYNIA (8) ___ GYRAULUS (8) ___ PHYSA (8) 6 PLANORBIDAE () 11 HYDROBIIDAE () ___ ANCYLIDAE () ___
PELECYPODA SPHAERIIDAE (8) 8 CORBICULA () ___ DRIESSENIA () ___

PLATYHELMINTHES TURBELLARIA (4) ___ ANNELIDA () ___ OLIGOCHAETA () 18 TUBIFICIDAE () ___ NAIDIDAE () ___
HIRUDINEA () ___ HELOBDELLA (10) ___ BRANCHIOBDELLIDA () ___ ERPOBDELLIDAE () ___ NEMATODA () ___

NUMBER OF VIALS FORWARDED: 14 PRELIMINARY NUMBER OF TAXA: 14 NUMBER OF INDIVIDUALS: 100
HBI: 7.77 EPT COUNT: 0 EPT ABUN./CHIR. ABUN.: 0 CHIRONOMID COUNT: 10
% DOMINANT TAXON: 23 EPT INDEX: 0 EPT/TOTAL COUNT: 0
PHASE 1 IDENTIFICATION COMPLETED BY: SZ DATE COMPLETED: 11/1/01 COUNTS & CALCULATION CHECK: SZ CS

APPENDIX C

QHEI DATA SHEETS

LAKE BRUCE WATERSHED LAND TREATMENT PROJECT AREA

FULTON COUNTY, INDIANA

STREAM: **Baker Ditch at CR 75N** RIVER MILE **Site 1** DATE: **26Jun2001** QHEI SCORE **26.7**

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE **1**

TYPE POOL	RIFFLE		POOL	RIFFLE	TYPE POOL	RIFFLE		POOL	RIFFLE
[ ]	[ ]	BLDER/SLAB(10)			[ ]	[ ]	GRAVEL(7)		
[ ]	[ ]	BOULDER(9)			[ ]	[ ]	SAND(6)		
[ ]	[ ]	COBBLE(8)			[ ]	[ ]	BEDROCK(5)		
[ ]	[ ]	HARDPAN(4)			[ ]	[ ]	DETRITUS(3)		
[X]	[X]	MUCK/SILT(2)			[ ]	[ ]	ARTIFIC(0)		

SUBSTRATE ORIGIN (all)
- [ ] LIMESTONE(1)
- [X] TILLS(1)
- [ ] SANDSTONE(0)
- [ ] SHALE(-1)
- [ ] COAL FINES(-2)
- [ ] RIP/RAP(0)
- [ ] HARDPAN(0)

SILT COVER (one)
- [X] SILT-HEAVY(-2)
- [ ] SILT-MOD(-1)
- [ ] SILT-NORM(0)
- [ ] SILT-FREE(1)

Extent of Embeddedness (check one)
- [X] EXTENSIVE(-2)
- [ ] MODERATE(-1)
- [ ] LOW(0)
- [ ] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS:

2) INSTREAM COVER: COVER SCORE **13**

TYPE (Check all that apply)
- [ ] UNDERCUT BANKS(1)
- [X] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [ ] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [X] AQUATIC MACROPHYTES(1)
- [ ] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)
- [X] EXTENSIVE >75%(11)
- [ ] MODERATE 25-75%(7)
- [ ] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE **4**

SINUOSITY
- [ ] HIGH(4)
- [ ] MODERATE(3)
- [ ] LOW(2)
- [X] NONE(1)

DEVELOPMENT
- [ ] EXCELLENT(7)
- [ ] GOOD(5)
- [ ] FAIR(3)
- [X] POOR(1)

CHANNELIZATION
- [ ] NONE(6)
- [ ] RECOVERED(4)
- [ ] RECOVERING(3)
- [X] RECENT OR NO RECOVERY(1)

STABILITY
- [ ] HIGH(3)
- [ ] MODERATE(2)
- [X] LOW(1)

MODIFICATION/OTHER
- [ ] SNAGGING
- [ ] RELOCATION
- [X] CANOPY REMOVAL
- [X] DREDGING
- [ ] ONE SIDE CHANNEL MODIFICATION
- [ ] IMPOUND
- [ ] ISLAND
- [ ] LEVEED
- [X] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank)

River Right Looking Downstream RIPARIAN SCORE **8.7**

RIPARIAN WIDTH (per bank)

L	R	(per bank)
[X]	[X]	WIDE >150 ft.(4)
[ ]	[ ]	MODERATE 30-150 ft.(3)
[ ]	[ ]	NARROW 15-30 ft.(2)
[ ]	[ ]	VERY NARROW 3-15 ft.(1)
[ ]	[ ]	NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
[X]	[X]	FOREST, SWAMP(3)	[ ]	[ ]	URBAN OR INDUSTRIAL(0)
[ ]	[ ]	OPEN PASTURE/ROW CROP(0)	[ ]	[ ]	SHRUB OR OLD FIELD(2)
[ ]	[ ]	RESID.,PARK,NEW FIELD(1)	[ ]	[ ]	CONSERV. TILLAGE(1)
[ ]	[ ]	FENCED PASTURE(1)	[ ]	[ ]	MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
[X]	[X]	NONE OR LITTLE(3)
[ ]	[ ]	MODERATE(2)
[ ]	[ ]	HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY **NO POOL = 0** POOL SCORE **0**

MAX.DEPTH (Check 1)
- [ ] >4 ft.(6)
- [ ] 2.4-4 ft.(4)
- [ ] 1.2-2.4 ft.(2)
- [ ] <1.2 ft.(1)
- [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)
- [ ] POOL WIDTH>RIFFLE WIDTH(2)
- [ ] POOL WIDTH=RIFFLE WIDTH(1)
- [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)
- [ ] TORRENTIAL(-1)
- [ ] FAST(1)
- [ ] MODERATE(1)
- [ ] SLOW(1)
- [ ] EDDIES(1)
- [ ] INTERSTITIAL(-1)
- [ ] INTERMITTENT(-2)

COMMENTS: **site is stagant; elevation is the same as the lake downstream so water is ponded upstream to the sampling location**

RIFFLE SCORE **0**

RIFFLE/RUN DEPTH
- [ ] GENERALLY >4 in. MAX.>20 in.(4)
- [ ] GENERALLY >4 in. MAX.<20 in.(3)
- [ ] GENERALLY 2-4 in.(1)
- [ ] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE
- [ ] STABLE (e.g., Cobble,Boulder)(2)
- [ ] MOD.STABLE (e.g., Pea Gravel)(1)
- [ ] UNSTABLE (Gravel, Sand)(0)
- [ ] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS
- [ ] EXTENSIVE(-1)
- [ ] MODERATE(0)
- [ ] LOW(1)
- [ ] NONE(2)
- [ ] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): **0** % POOL **100** % RIFFLE **0** % RUN **0** GRADIENT SCORE **0**

STREAM: **Overmeyer Ditch at CR 1125W** RIVER MILE **Site 2** DATE: **26Jun2001** QHEI SCORE **32**

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE **8**

TYPE			POOL	RIFFLE				POOL	RIFFLE
[ ]	[ ]	BLDER/SLAB(10)			[ ]	[ ]	GRAVEL(7)		
[ ]	[ ]	BOULDER(9)			[ ]	[X]	SAND(6)		
[ ]	[ ]	COBBLE(8)			[ ]	[ ]	BEDROCK(5)		
[ ]	[ ]	HARDPAN(4)			[ ]	[ ]	DETRITUS(3)		
[ ]	[ ]	MUCK/SILT(2)			[ ]	[X]	ARTIFIC(0)		

SUBSTRATE ORIGIN (all)
- [ ] LIMESTONE(1)
- [ ] RIP/RAP(0)
- [X] TILLS(1)
- [ ] HARDPAN(0)
- [ ] SANDSTONE(0)
- [ ] SHALE(-1)
- [ ] COAL FINES(-2)

SILT COVER (one)
- [ ] SILT-HEAVY(-2)
- [ ] SILT-MOD(-1)
- [X] SILT-NORM(0)
- [ ] SILT-FREE(1)

Extent of Embeddedness (check one)
- [ ] EXTENSIVE(-2)
- [X] MODERATE(-1)
- [ ] LOW(0)
- [ ] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS:

2) INSTREAM COVER: COVER SCORE **8**

TYPE (Check all that apply)
- [ ] UNDERCUT BANKS(1)
- [ ] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [ ] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [X] AQUATIC MACROPHYTES(1)
- [ ] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)
- [ ] EXTENSIVE >75%(11)
- [X] MODERATE 25-75%(7)
- [ ] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE **7**

SINUOSITY
- [ ] HIGH(4)
- [ ] MODERATE(3)
- [X] LOW(2)
- [ ] NONE(1)

DEVELOPMENT
- [ ] EXCELLENT(7)
- [ ] GOOD(5)
- [ ] FAIR(3)
- [X] POOR(1)

CHANNELIZATION
- [ ] NONE(6)
- [ ] RECOVERED(4)
- [X] RECOVERING(3)
- [ ] RECENT OR NO RECOVERY(1)

STABILITY
- [ ] HIGH(3)
- [X] MODERATE(2)
- [ ] LOW(1)

MODIFICATION/OTHER
- [ ] SNAGGING
- [ ] RELOCATION
- [X] CANOPY REMOVAL
- [ ] DREDGING
- [ ] ONE SIDE CHANNEL MODIFICATION
- [ ] IMPOUND
- [ ] ISLAND
- [ ] LEVEED
- [ ] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank)

River Right Looking Downstream RIPARIAN SCORE **9**

RIPARIAN WIDTH (per bank)

L	R	(per bank)
[ ]	[X]	WIDE >150 ft.(4)
[X]	[ ]	MODERATE 30-150 ft.(3)
[ ]	[ ]	NARROW 15-30 ft.(2)
[ ]	[ ]	VERY NARROW 3-15 ft.(1)
[ ]	[ ]	NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
[X]	[ ]	FOREST, SWAMP(3)	[ ]	[ ]	URBAN OR INDUSTRIAL(0)
[X]	[X]	OPEN PASTURE/ROW CROP(0)	[ ]	[X]	SHRUB OR OLD FIELD(2)
[ ]	[ ]	RESID.,PARK,NEW FIELD(1)	[ ]	[ ]	CONSERV. TILLAGE(1)
[ ]	[ ]	FENCED PASTURE(1)	[ ]	[ ]	MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
[X]	[X]	NONE OR LITTLE(3)
[ ]	[ ]	MODERATE(2)
[ ]	[ ]	HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY **NO POOL = 0** POOL SCORE **0**

MAX.DEPTH (Check 1)
- [ ] >4 ft.(6)
- [ ] 2.4-4 ft.(4)
- [ ] 1.2-2.4 ft.(2)
- [ ] <1.2 ft.(1)
- [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)
- [ ] POOL WIDTH>RIFFLE WIDTH(2)
- [ ] POOL WIDTH=RIFFLE WIDTH(1)
- [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)
- [ ] TORRENTIAL(-1)
- [ ] FAST(1)
- [ ] MODERATE(1)
- [ ] SLOW(1)
- [ ] EDDIES(1)
- [ ] INTERSTITIAL(-1)
- [ ] INTERMITTENT(-2)

COMMENTS: **site is very close to the lake; at the same elevation as the lake; stream is stagnant or flowing very slowly**

RIFFLE SCORE **0**

RIFFLE/RUN DEPTH
- [ ] GENERALLY >4 in. MAX.>20 in.(4)
- [ ] GENERALLY >4 in. MAX.<20 in.(3)
- [ ] GENERALLY 2-4 in.(1)
- [ ] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE
- [ ] STABLE (e.g., Cobble,Boulder)(2)
- [ ] MOD.STABLE (e.g., Pea Gravel)(1)
- [ ] UNSTABLE (Gravel, Sand)(0)
- [ ] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS
- [ ] EXTENSIVE(-1)
- [ ] MODERATE(0)
- [ ] LOW(1)
- [ ] NONE(2)
- [ ] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): **0** % POOL **100** % RIFFLE **0** % RUN **0** GRADIENT SCORE **0**

STREAM: **Overmeyer Ditch at CR 125N** RIVER MILE **Site 3** DATE: **26Jun2001** QHEI SCORE **30**

1) SUBSTRATE: (Check ONLY Two Substrate Type Boxes: Check all types present) SUBSTRATE SCORE **1**

TYPE			POOL	RIFFLE				POOL	RIFFLE
[ ]	[ ]	BLDER/SLAB(10)			[ ]	[ ]	GRAVEL(7)		
[ ]	[ ]	BOULDER(9)			[ ]	[ ]	SAND(6)		
[ ]	[ ]	COBBLE(8)			[ ]	[ ]	BEDROCK(5)		
[ ]	[ ]	HARDPAN(4)			[ ]	[ ]	DETRITUS(3)		
[X]	[X]	MUCK/SILT(2)			[ ]	[ ]	ARTIFIC(0)		

SUBSTRATE ORIGIN (all)
- [ ] LIMESTONE(1)
- [ ] RIP/RAP(0)
- [X] TILLS(1)
- [ ] HARDPAN(0)
- [ ] SANDSTONE(0)
- [ ] SHALE(-1)
- [ ] COAL FINES(-2)

SILT COVER (one)
- [X] SILT-HEAVY(-2)
- [ ] SILT-MOD(-1)
- [ ] SILT-NORM(0)
- [ ] SILT-FREE(1)

Extent of Embeddedness (check one)
- [X] EXTENSIVE(-2)
- [ ] MODERATE(-1)
- [ ] LOW(0)
- [ ] NONE(1)

TOTAL NUMBER OF SUBSTRATE TYPES: [ ] >4(2) [X] <4(0)

NOTE: (Ignore sludge that originates from point sources: score is based on natural substrates)

COMMENTS:

2) INSTREAM COVER: COVER SCORE **9**

TYPE (Check all that apply)
- [ ] UNDERCUT BANKS(1)
- [X] OVERHANGING VEGETATION(1)
- [ ] SHALLOWS (IN SLOW WATER)(1)
- [ ] DEEP POOLS(2)
- [ ] ROOTWADS(1)
- [ ] BOULDERS(1)
- [ ] OXBOWS(1)
- [X] AQUATIC MACROPHYTES(1)
- [ ] LOGS OR WOODY DEBRIS(1)

AMOUNT (Check only one or Check 2 and AVERAGE)
- [ ] EXTENSIVE >75%(11)
- [X] MODERATE 25-75%(7)
- [ ] SPARSE 5-25%(3)
- [ ] NEARLY ABSENT <5%(1)

COMMENTS:

3) CHANNEL MORPHOLOGY: (Check ONLY ONE per Category or Check 2 and AVERAGE) CHANNEL SCORE **5**

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
[ ] HIGH(4)	[ ] EXCELLENT(7)	[ ] NONE(6)	[ ] HIGH(3)
[ ] MODERATE(3)	[ ] GOOD(5)	[ ] RECOVERED(4)	[X] MODERATE(2)
[ ] LOW(2)	[ ] FAIR(3)	[ ] RECOVERING(3)	[ ] LOW(1)
[X] NONE(1)	[X] POOR(1)	[X] RECENT OR NO RECOVERY(1)	

MODIFICATION/OTHER
- [X] SNAGGING
- [ ] RELOCATION
- [X] CANOPY REMOVAL
- [ ] DREDGING
- [ ] ONE SIDE CHANNEL MODIFICATION
- [ ] IMPOUND
- [ ] ISLAND
- [ ] LEVEED
- [X] BANK SHAPING

COMMENTS:

4) RIPARIAN ZONE AND BANK EROSION: (Check ONE box or Check 2 and AVERAGE per bank)

River Right Looking Downstream RIPARIAN SCORE **7**

RIPARIAN WIDTH (per bank)

L	R	(per bank)
[ ]	[X]	WIDE >150 ft.(4)
[ ]	[ ]	MODERATE 30-150 ft.(3)
[X]	[ ]	NARROW 15-30 ft.(2)
[ ]	[ ]	VERY NARROW 3-15 ft.(1)
[ ]	[ ]	NONE(0)

EROSION/RUNOFF-FLOODPLAIN QUALITY

L	R	(most predominant per bank)	L	R	(per bank)
[ ]	[ ]	FOREST, SWAMP(3)	[ ]	[ ]	URBAN OR INDUSTRIAL(0)
[X]	[ ]	OPEN PASTURE/ROW CROP(0)	[ ]	[X]	SHRUB OR OLD FIELD(2)
[ ]	[ ]	RESID.,PARK,NEW FIELD(1)	[ ]	[ ]	CONSERV. TILLAGE(1)
[ ]	[ ]	FENCED PASTURE(1)	[ ]	[ ]	MINING/CONSTRUCTION(0)

BANK EROSION

L	R	(per bank)
[X]	[X]	NONE OR LITTLE(3)
[ ]	[ ]	MODERATE(2)
[ ]	[ ]	HEAVY OR SEVERE(1)

COMMENTS:

5) POOL/GLIDE AND RIFFLE/RUN QUALITY **NO POOL = 0** POOL SCORE **0**

MAX.DEPTH (Check 1)
- [ ] >4 ft.(6)
- [ ] 2.4-4 ft.(4)
- [ ] 1.2-2.4 ft.(2)
- [ ] <1.2 ft.(1)
- [ ] <0.6 ft.(Pool=0)(0)

MORPHOLOGY (Check 1)
- [ ] POOL WIDTH>RIFFLE WIDTH(2)
- [ ] POOL WIDTH=RIFFLE WIDTH(1)
- [ ] POOL WIDTH<RIFFLE WIDTH(0)

POOL/RUN/RIFFLE CURRENT VELOCITY (Check all that Apply)
- [ ] TORRENTIAL(-1)
- [ ] FAST(1)
- [ ] MODERATE(1)
- [ ] SLOW(1)
- [ ] EDDIES(1)
- [ ] INTERSTITIAL(-1)
- [ ] INTERMITTENT(-2)

COMMENTS: **site is furthest upstream; this site was chosen as an alternate, due to the angry landowner on Frasa Ditch**

RIFFLE SCORE **0**

RIFFLE/RUN DEPTH
- [ ] GENERALLY >4 in. MAX.>20 in.(4)
- [ ] GENERALLY >4 in. MAX.<20 in.(3)
- [ ] GENERALLY 2-4 in.(1)
- [ ] GENERALLY <2 in.(Riffle=0)(0)

RIFFLE/RUN SUBSTRATE
- [ ] STABLE (e.g., Cobble,Boulder)(2)
- [ ] MOD.STABLE (e.g., Pea Gravel)(1)
- [ ] UNSTABLE (Gravel, Sand)(0)
- [ ] NO RIFFLE(0)

RIFFLE/RUN EMBEDDEDNESS
- [ ] EXTENSIVE(-1)
- [ ] MODERATE(0)
- [ ] LOW(1)
- [ ] NONE(2)
- [ ] NO RIFFLE(0)

COMMENTS:

6) GRADIENT (FEET/MILE): **12.1** % POOL **0** % RIFFLE **0** % RUN **100** GRADIENT SCORE **8**